

# DOE Zero Energy Ready Home

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## Zero Energy Ready Home Training

**SAM RASHKIN**

Chief Architect

Building Technologies Office

Credit(s) earned on completion of this course will be reported to **AIA CES** for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

**CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

---

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

This course is registered with **AIA**



DOE Zero Energy Ready Home training sessions provide dynamic content on the business case and technical strategies to successfully design and build zero energy ready homes in today's market. The training features multiple modules covering the business advantages of high performance building, marketing to consumers, advanced building specifications and systems, and gaining recognition through DOE Zero Energy Ready Home.



# Learning Objectives

1. Understand the business case for constructing zero energy ready homes.
2. Recognize the home buyer value propositions for purchasing zero net-energy homes.
3. Understand the DOE technical specifications associated with zero energy ready performance.
4. Understand how to gain recognition for construction zero energy ready homes with the DOE Zero Energy Ready Home program







## **Web Site:**

[www.buildings.energy.gov/zero/](http://www.buildings.energy.gov/zero/)

## **e-mail Contact:**

[zero@newportpartnersllc.com](mailto:zero@newportpartnersllc.com)



- Zero Business Solution:
  - Zero Building Blocks
  - Zero Common Agenda
  - Zero for Informed Buyers
  - Zero Value Translated
- Zero Builders in Action
  - Name 1
  - Name 2



- Zero Specifications
  - Optimized Enclosure System
  - Water Protection Systems
  - Optimized Comfort System
  - Comprehensive IAQ System
  - Efficient Component System
  - Solar Ready System
  - Summary
- Zero Recognition
  - Zero Energy Ready Home Resources
  - Partnering with Zero Energy Ready Home
  - Meet the Raters: Local Solution



# Zero Energy Ready Home Training

# **Zero Building Blocks**

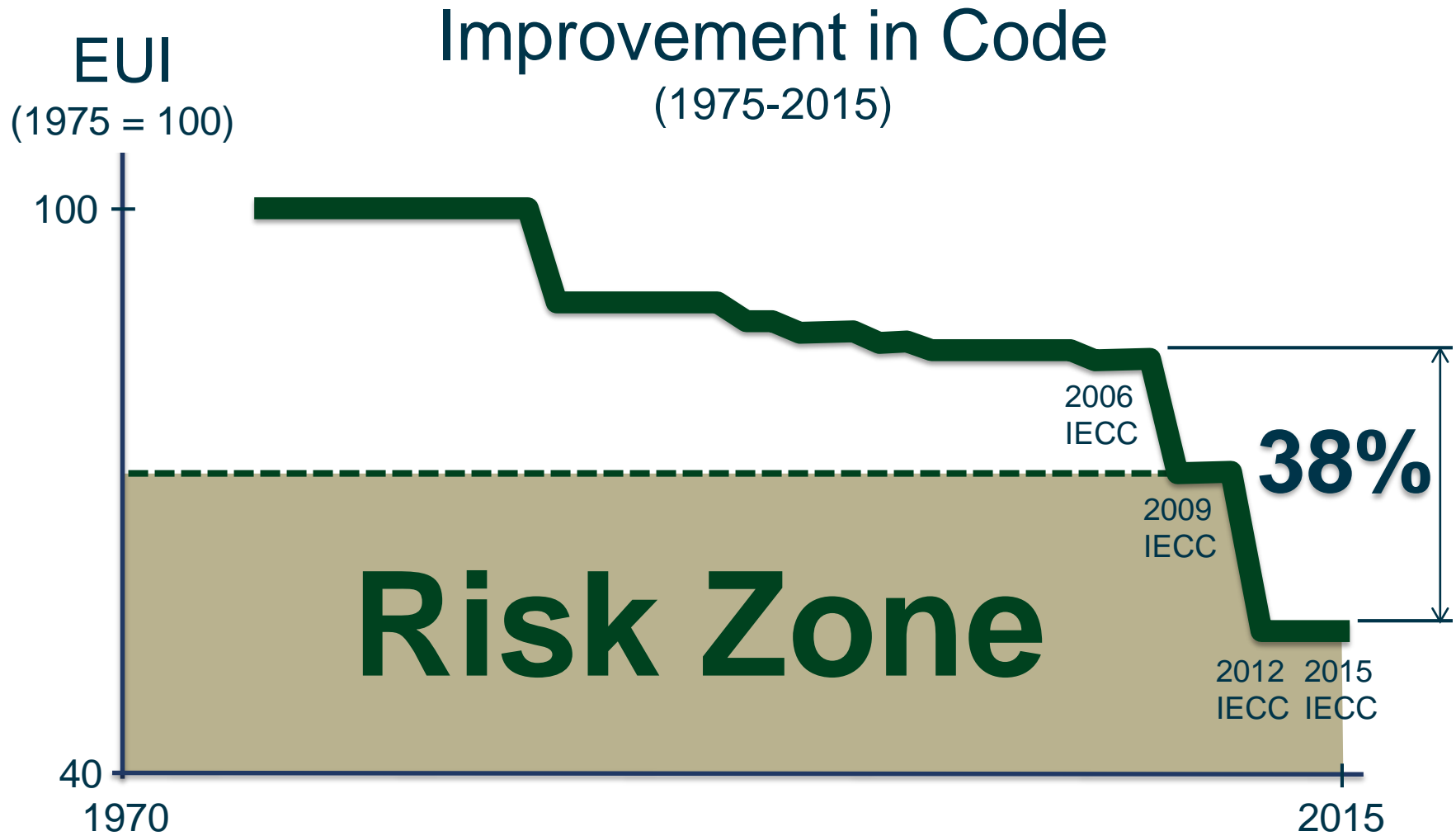


Image Basis: Building Energy Codes Program: National Benefits Assessment, 1992-2040,  
[https://www.energycodes.gov/sites/default/files/documents/BenefitsReport\\_Final\\_March20142.pdf](https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf)



# New Risk Reality Driver

## Six Building Blocks to Manage Risks



**Risk Driver:**  
Advanced  
Enclosure

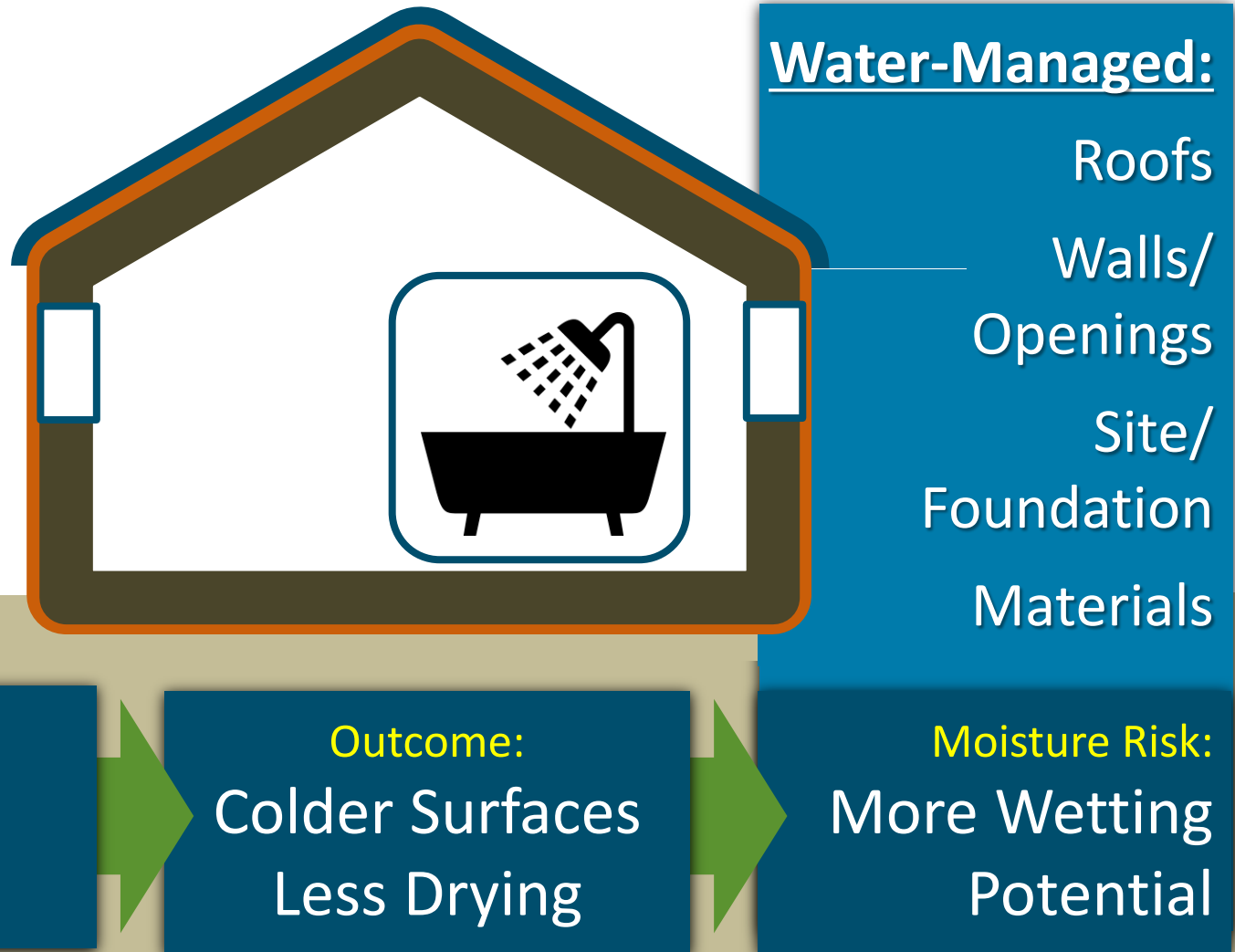
**Outcome:**  
+ Insulation  
+ Windows  
+ Air Sealing

**Reality:**  
> Code Rigor  
< HERS Index

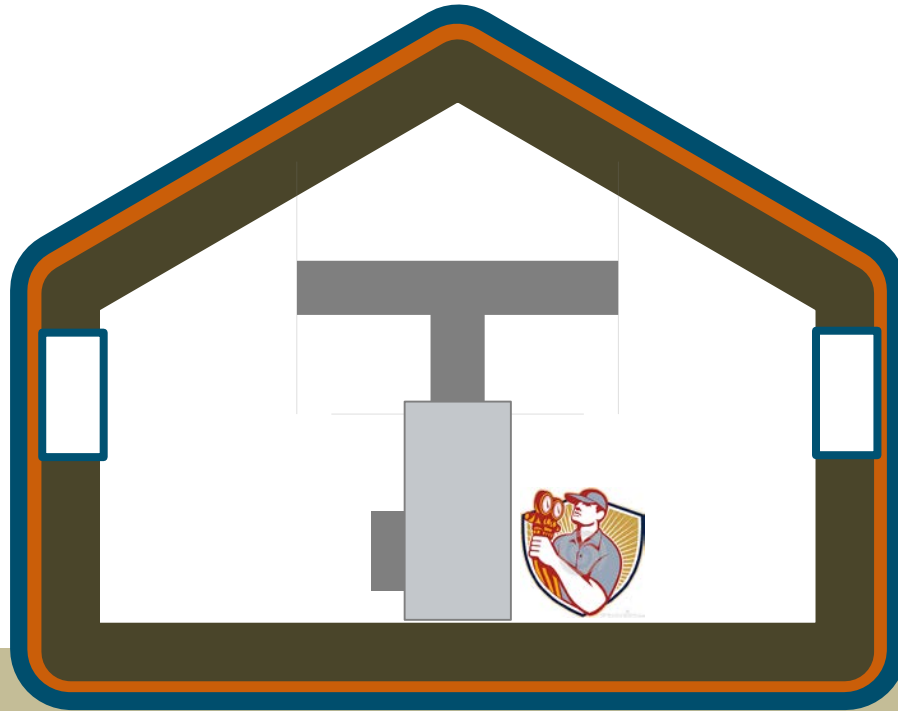
# Building Block #1: Whole-House Water Protection

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Building Block #2: Ensured Comfort



## HVAC QI:

Right-Sizing  
Var. Speed

Ducts in  
Cond. Space

Proper  
Installation

Complete

### Risk Driver:

Advanced  
Enclosure

### Outcome:

< Loads, > MRT Control  
< Air Flow, > Swing Season

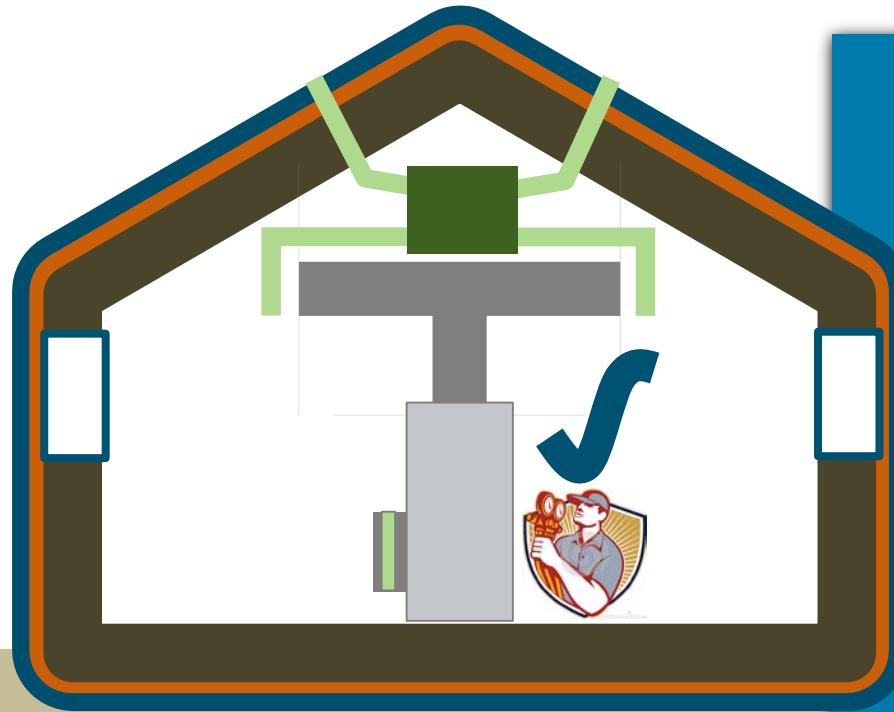
### Comfort Risk:

< Mixing  
< RH Control

# Building Block #3: Comprehensive Indoor Air Quality

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## IAQ System:

Source  
Control

Fresh Air  
System

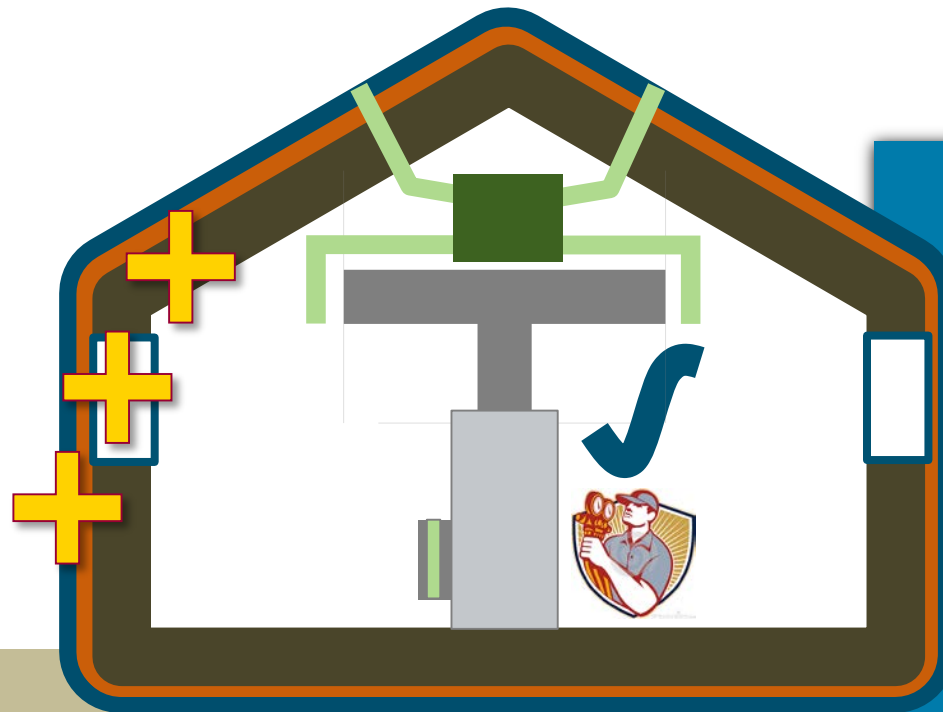
High-Capture  
Filtration

**Risk Driver:**  
Advanced  
Enclosure

**Outcome:**  
Less  
Air Exchange

**IAQ Risk:**  
More  
Contaminants

# Building Block #4: Optimized Enclosure



## Future Code:

- + Air Tight
- + Window Eff.
- + Insulation

Risk Driver:  
Optimized  
Enclosure

Outcome:  
3-Year  
Code Cycle

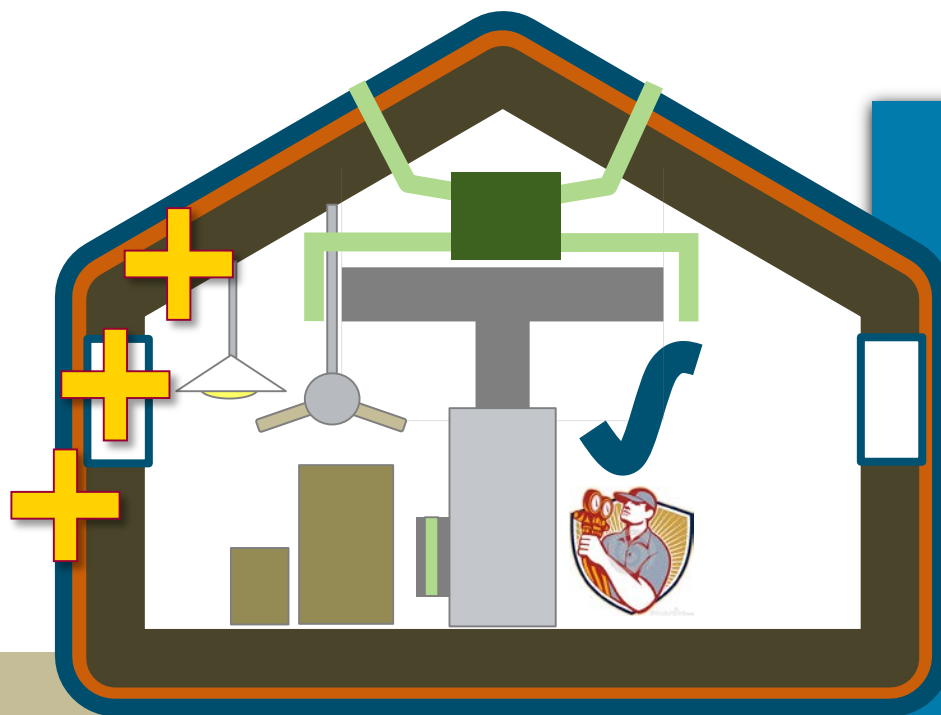
Investment Risk:  
Near-Term  
Obsolescence



# Building Block #5: High-Efficiency Components

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## **ENERGY STAR:**

Equipment  
Lighting  
Appliances  
Fans

**Risk Driver:**  
Optimized  
Enclosure

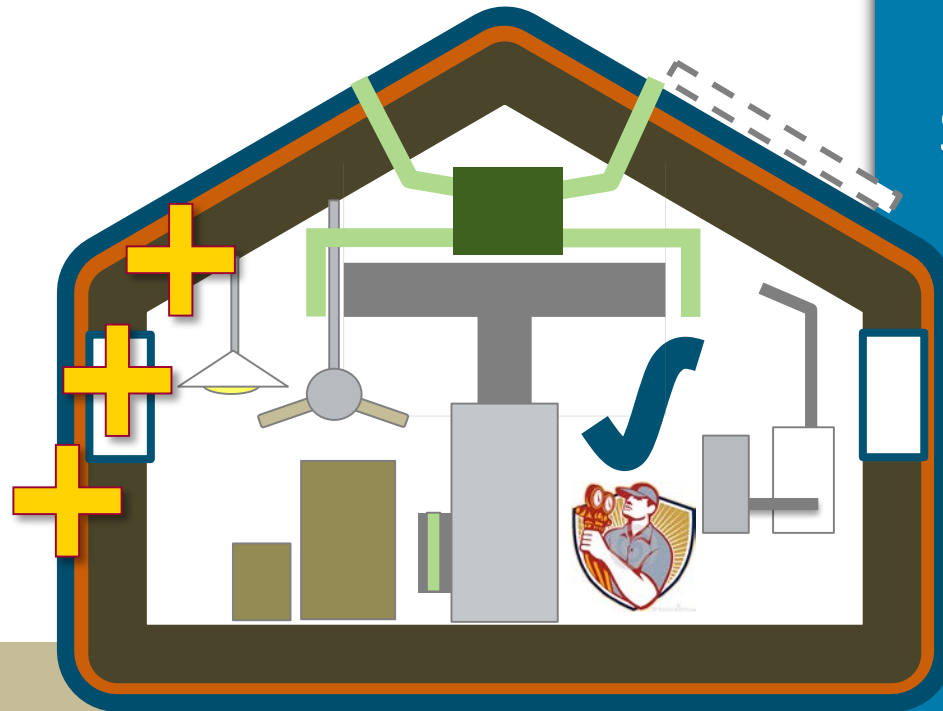
**Outcome:**  
Heating/Cooling  
< 50% Load

**Efficiency Risk:**  
Components  
Energy Use

# Building Block #6: Solar Ready Construction

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



## Solar Ready:

Structural Calcs

Conduit for  
Wiring

BOS Space

Extra Circuit  
Breakers

Risk Driver:

Optimized  
Enclosure

Outcome:

Ultra-Low HVAC  
Eff. Components

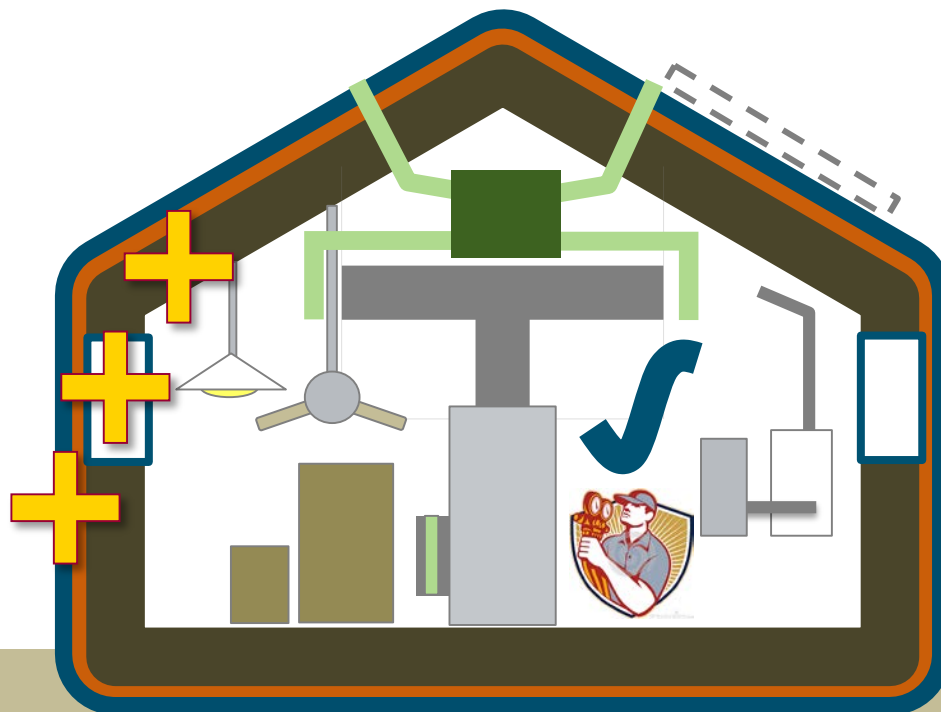
Path to Zero Risk:

Zero  
Ready

# Zero Six Building Blocks Summary

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Optimized  
Enclosure

Water  
Protection

Ensured  
Comfort

Indoor Air  
Quality

Efficient  
Comps

Solar  
Ready

Complete Risk Management Systems



# Zero Energy Ready Home Training

# **Zero Common Agenda**

## 2015-16 ZE PROJECTS, BUILDINGS, & UNITS



**741**

PROJECTS  
408 IN 2015



**4,077**

BUILDINGS  
3,339 IN 2015



**8,203**

UNITS  
6,177 IN 2015

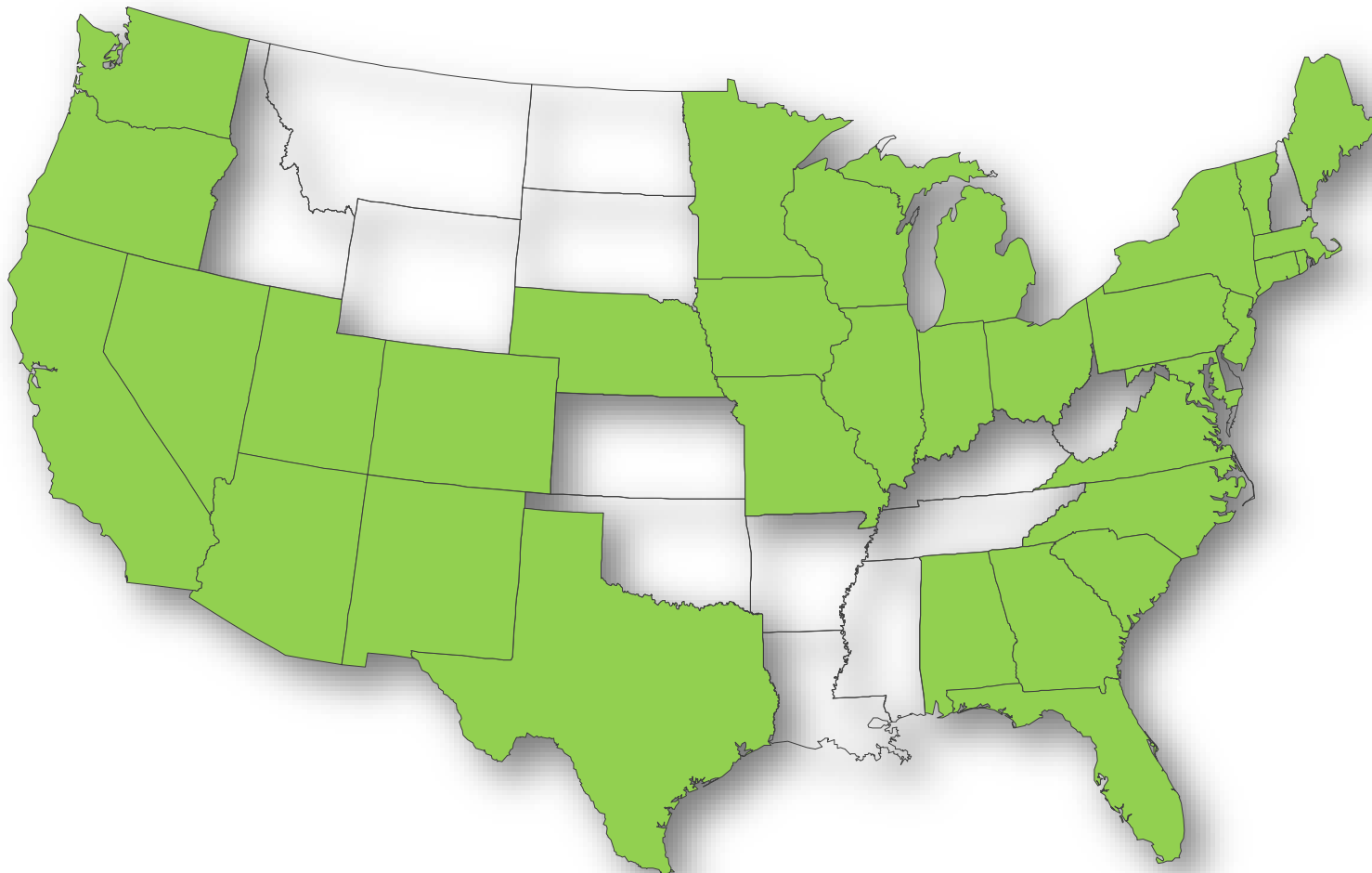
NOT INCLUDING PLANNED UNITS/PROJECTS

- **33% BUILDINGS GROWTH IN A SINGLE YEAR**
- **82% PROJECT GROWTH IN A SINGLE YEAR**

Source: "To Zero and Beyond, Zero Energy Residential Buildings Study, 2016 Inventory of residential projects on the path to zero in the U.S. and Canada, Net Zero Energy Coalition, June 2017



## States with ZERH



## Zero:

- Name
- Strategy
- Threshold
- Simple Definition

## ‘Net’ Out:

- Protect Valuable Real Estate
- Ensure Simplicity



# Zero Name: Why 'Net' Out



# Zero Name: Why 'Net' Out





## ‘Net’

Out:

- Protect Valuable Real Estate
- Ensure Simplicity



## ‘Ready’

In:

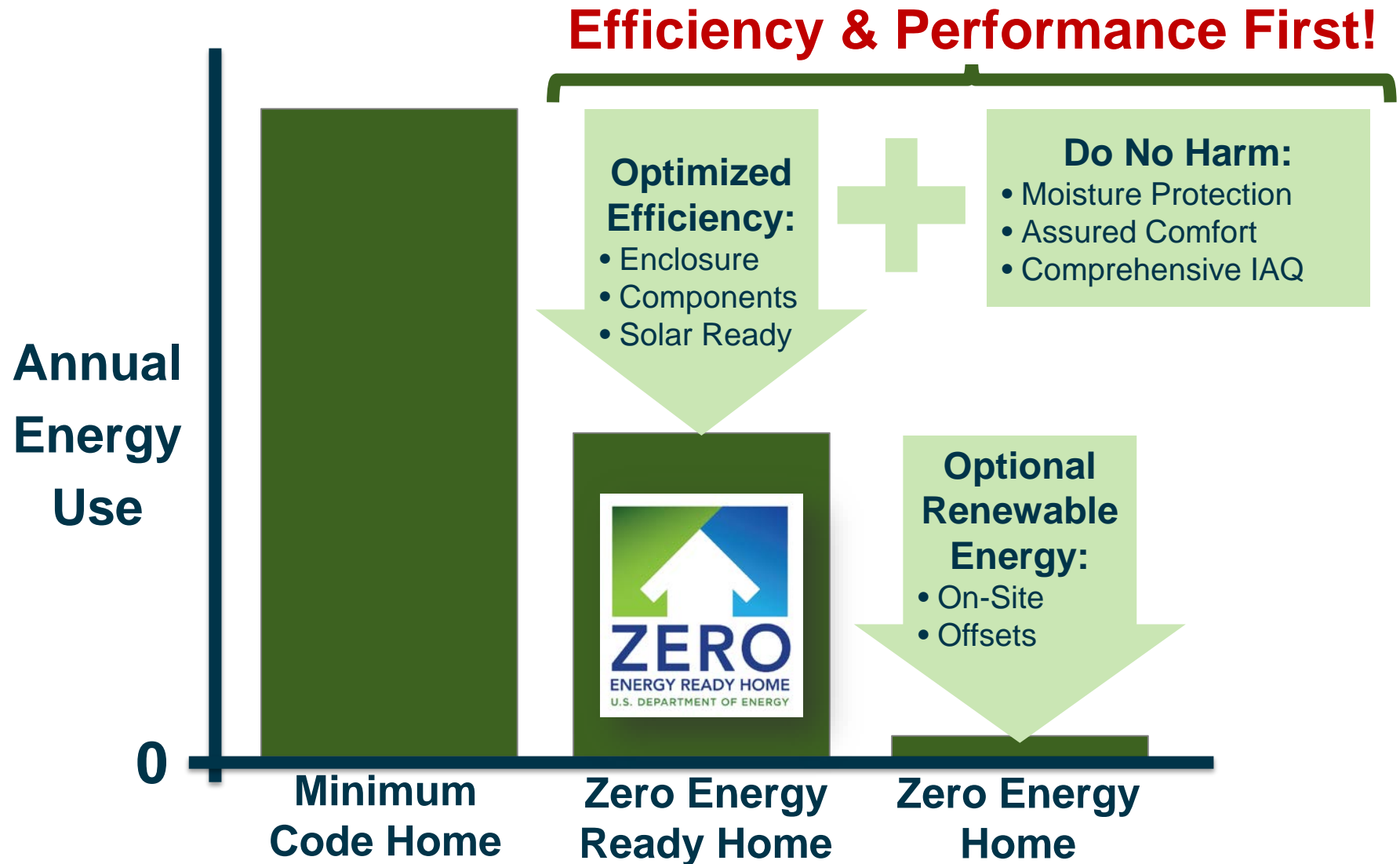
- Protect Core Customer Liability
- Inclusive vs. Exclusive

## **Substantial Uncertainty:**

- **Software Predictions**
  - HERS Predicted vs. Actual Energy Use
  - HERS Analysis Results Among Raters
- **Occupant Impacts**
  - Number
  - Equipment
  - Behavior
  - Maintenance
- **External Forces**
  - Year-to-Year Weather
  - Utility Solar Power Purchase Charges

## **Don't Exclude Homes with:**

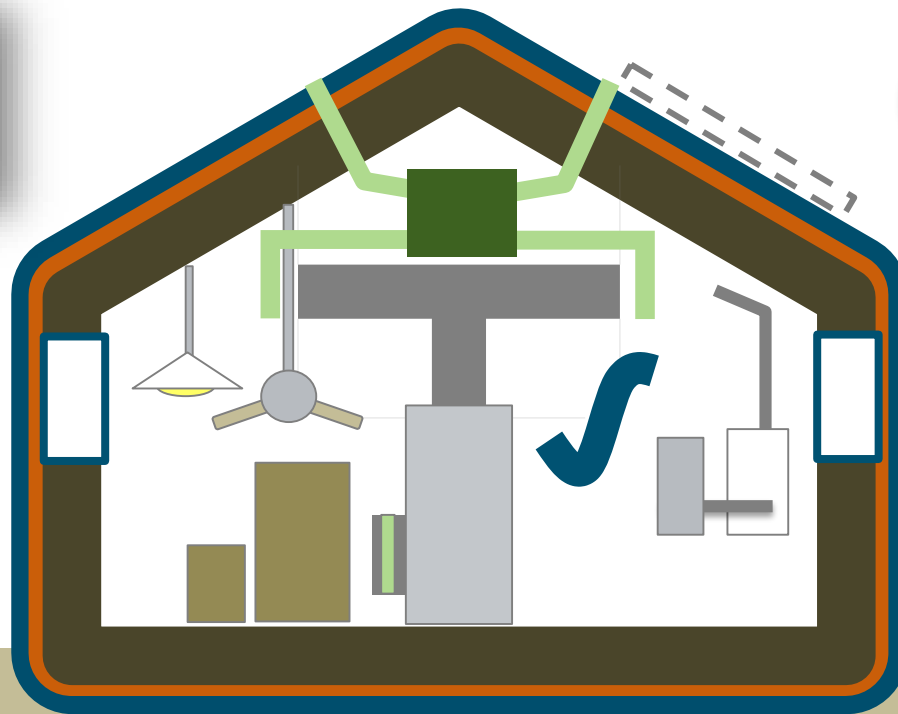
- Shading
  - Trees
  - Buildings
  - Architecture
- Low Insolation Locations
- Inadequate Roof Area
  - South-Facing
  - Multi-Stories



# Zero Threshold

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Optimized  
Enclosure  
System

Water  
Protection  
System

Optimized  
Comfort  
System

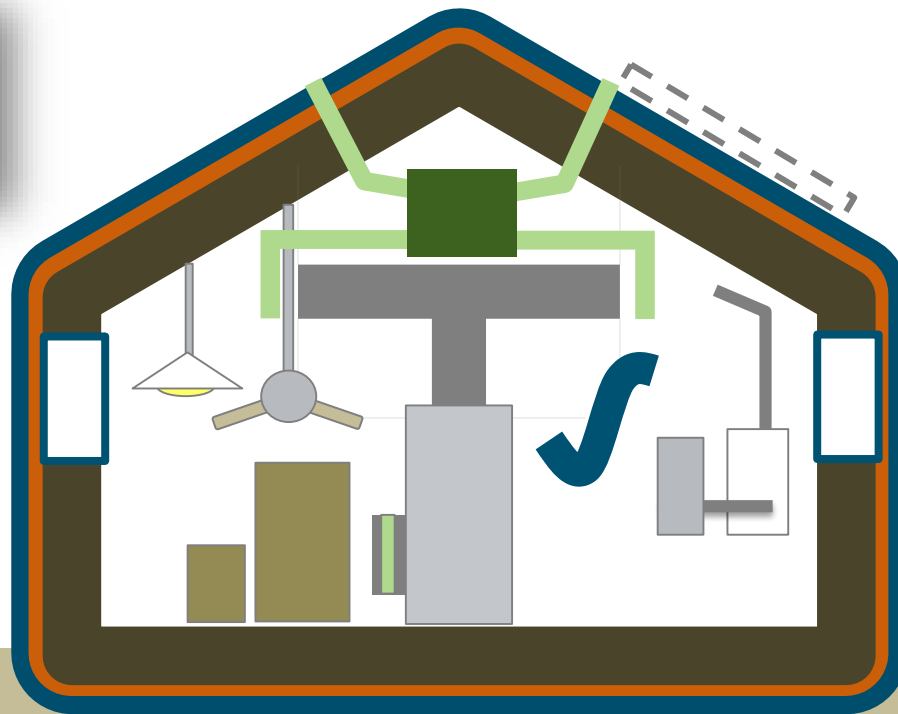
Indoor Air  
Quality  
System

Efficient  
Comps  
System

Solar  
Ready  
System

Six Complete Risk Management Systems

# Zero Simple Definition

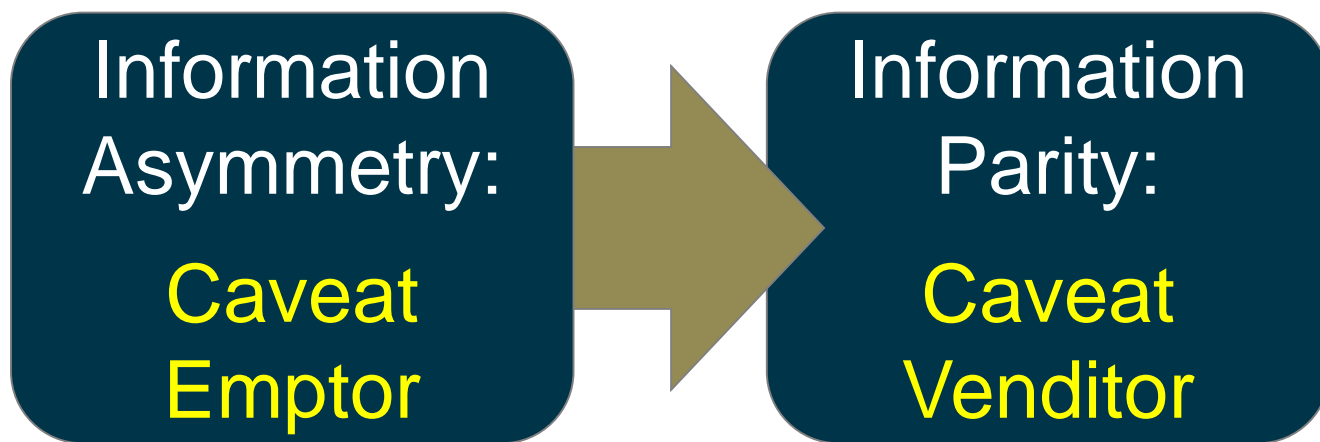


**High-performance home, so energy efficient,**  
all or most annual energy consumption  
can be offset by renewable energy.



# Zero Energy Ready Home Training

## **Zero for Informed Buyers**

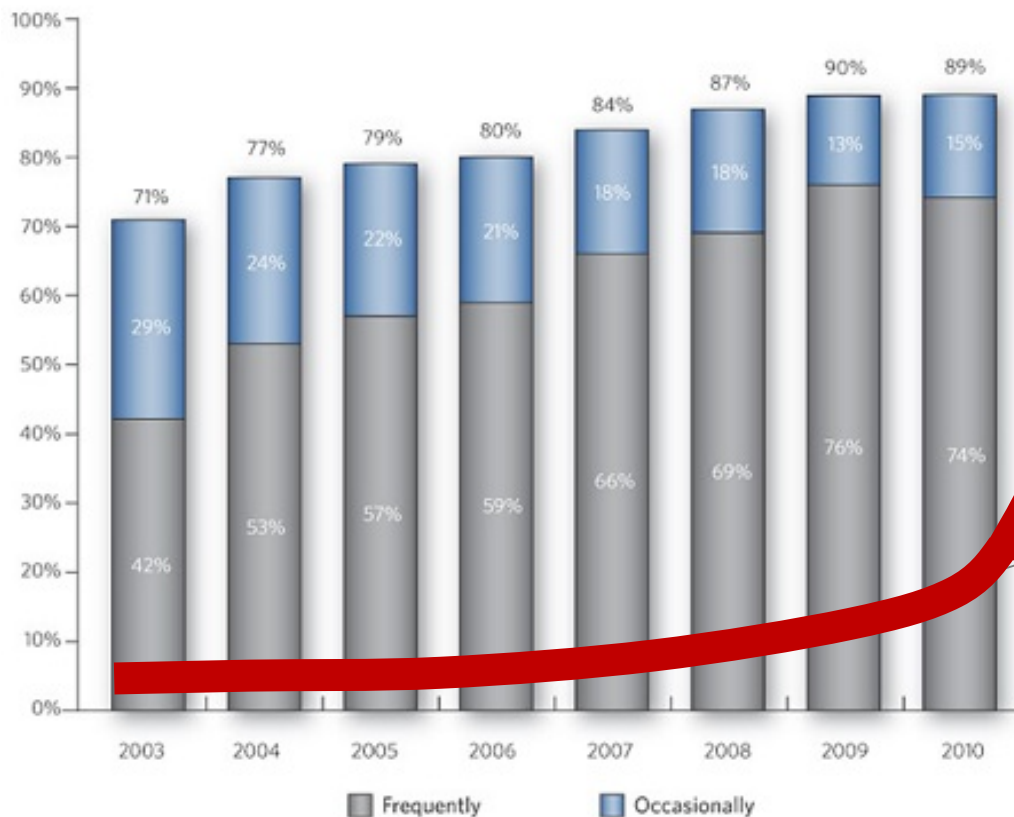




# More Informed Homebuyers

**Exhibit 3-13**

**USE OF INTERNET TO SEARCH FOR HOMES, 2003-2010**



Internet  
Content  
Coming  
Soon

Internet  
Content  
Available  
Now

SOURCE: National Association of Realtors® - Profile of Home Buyers and sellers 2010

# Informed Homebuyer Catalyst

U.S. DEPARTMENT OF  
**ENERGY**

## Energy Efficiency & Renewable Energy



BBC

Sign in

News

Sport

Weather

Shop

Earth

Travel

More

Search



future

What is BBC Future?

Latest

Future Now

Video

OUR PICKS

Best of Future

SPECIAL SERIES

Grand Challenges

Tomorrow's Skies

PRESENTED BY:



Plymouth University psychologists 2014 study showed that householders who received thermal images of their homes were

**4.9 times more likely**

to install draught proofing than those just presented with an energy audit

Sustainability | Electricity | Britain

The man who makes you see  
the invisible

britain

special series

One solution for reducing carbon footprints – and household bills – is increased energy efficiency. With infrared imaging, inventor Brian Harper is helping people to see exactly how.

By Nic Fleming

14 June 2017

Follow BBC Future

Facebook

Twitter



Nearly three-quarters of Bristol residents who were shown thermal imaging of their home's heat loss took some kind of action.



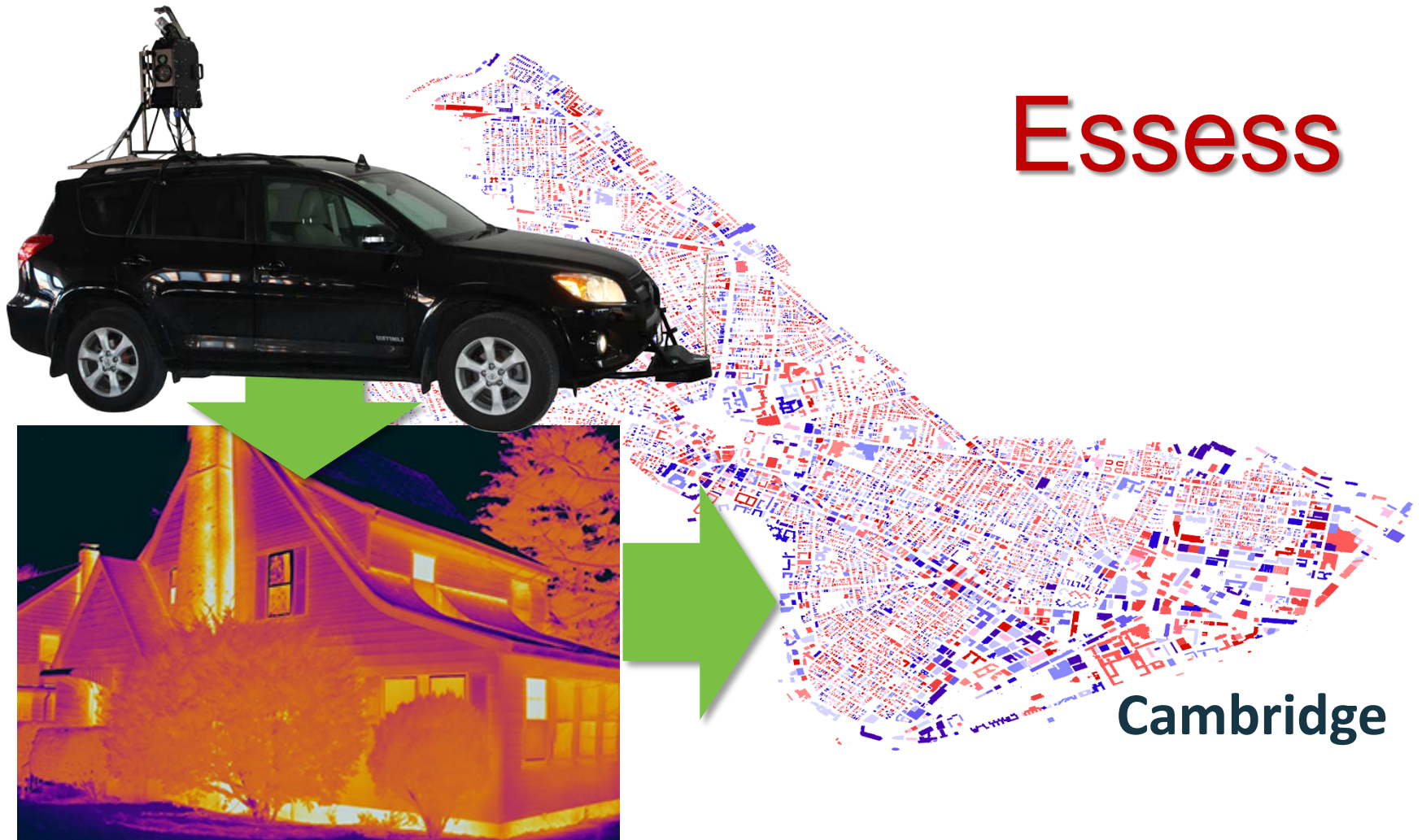
# Cheap IR Cameras



# Mobile IR Cameras

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Drone IR Cameras





# Airborne IR Cameras

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



[Case Studies](#) [Technology](#) [FAQ](#) [Sign Up](#) [Donate Data](#) [More ...](#)

## Energy made visible.

Make changes at home today that will  
have a global impact tomorrow.

[SELECT YOUR CITY](#) ▼

[LEARN MORE](#)

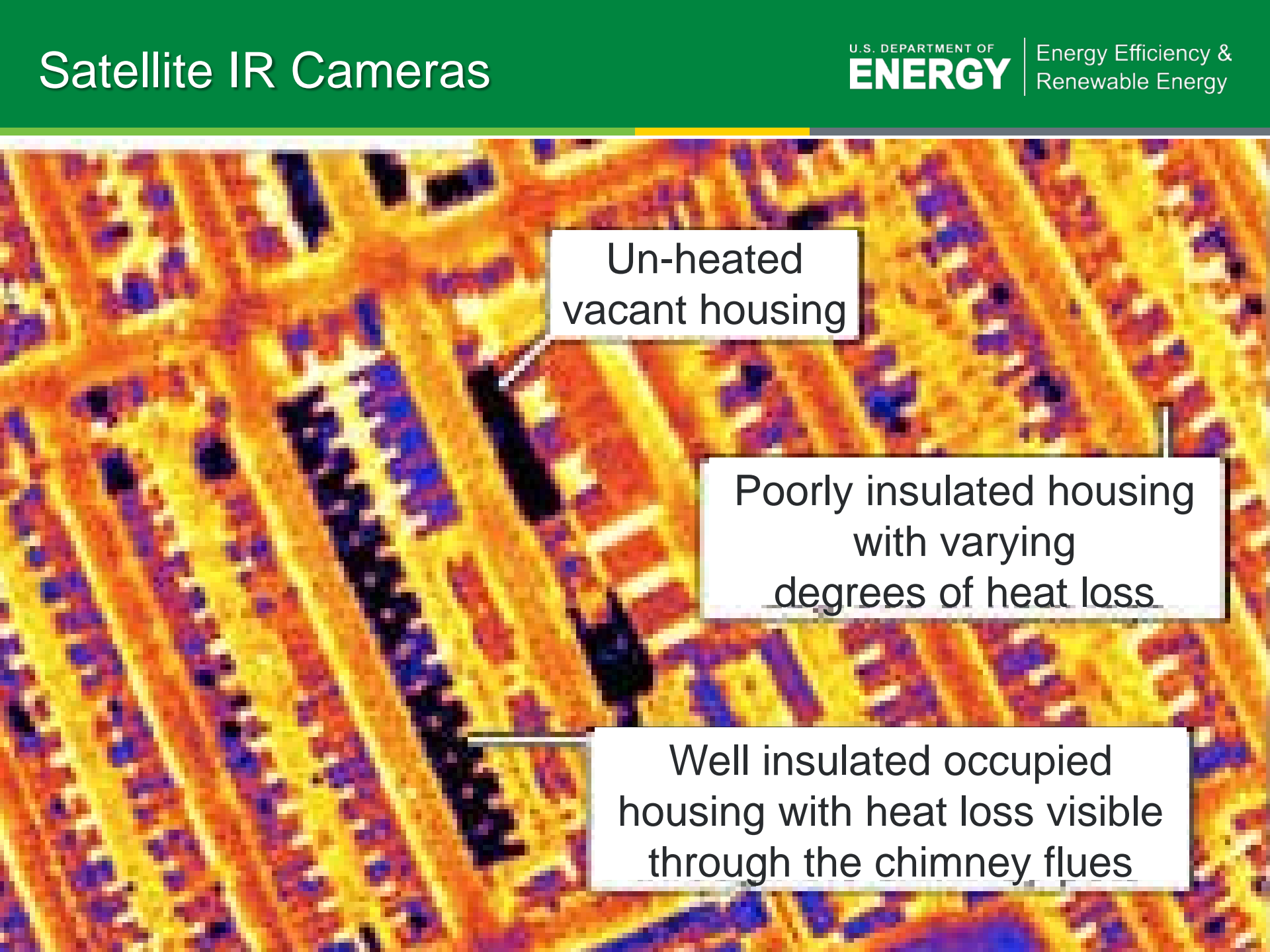
St. Albert, Alberta, Canada



# Satellite IR Cameras

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

A satellite infrared (IR) camera image of a residential neighborhood. The image uses a color scale where blue and purple represent cooler temperatures, while yellow, orange, and red represent warmer temperatures. The layout of the houses and streets is visible. Three specific areas are highlighted with white boxes and leader lines: a dark blue/purple area in the upper left, a large yellow/orange area in the center, and a red/orange area in the lower right.

Un-heated  
vacant housing

Poorly insulated housing  
with varying  
degrees of heat loss

Well insulated occupied  
housing with heat loss visible  
through the chimney flues



How to ...

Search.....

3-1-1

Green  
Vancouver

Your  
Government

About  
Vancouver

Parks, Recreation,  
and Culture

Home, Property, and  
Development

People and  
Programs

Streets and  
Transportation

Doing  
Business

Home > Green Vancouver > How you can go green > Programs to help reduce your footprint > At home > Thermal imaging program

## Green Vancouver

- ▶ [Greenest City Action Plan](#)
- ▶ [Renewable City Strategy: our future to 2050](#)
- ▶ [Zero Waste Vancouver](#)
- ▶ [Climate Change Adaptation Strategy](#)
- ▶ [Neighbourhood Energy Strategy](#)
- ▶ [How you can go green](#)
  - ▶ [Programs to help reduce your footprint](#)
    - ▶ [At home](#)
      - ▶ [Smart Thermostat Pilot Program](#)
      - Thermal Imaging program**
      - [At work](#)

## Thermal Imaging program

We launched a thermal imaging pilot program in January to help homeowners identify energy loss in single family homes and to share information on energy saving incentives that are available. We've identified [five neighbourhoods](#) (220 KB) to participate in the pilot. The images will be taken throughout the month of January and staff will follow-up with homeowners later this spring.

### What is a thermal image?

A thermal image is a picture of the heat that comes off of an object. Often in a thermal image, when something is hot, the image is bright yellow; if something is cold, it shows up as dark blue.

Thermal imaging is becoming an increasingly popular tool around the world to quickly identify opportunities for energy efficiency upgrades to a home that will also improve comfort and may improve health.

### Discover your home's energy efficiency potential

In Vancouver, 55% of all greenhouse gas (GHG) emissions come from buildings, and detached homes account for 31% of all GHG emissions from buildings.

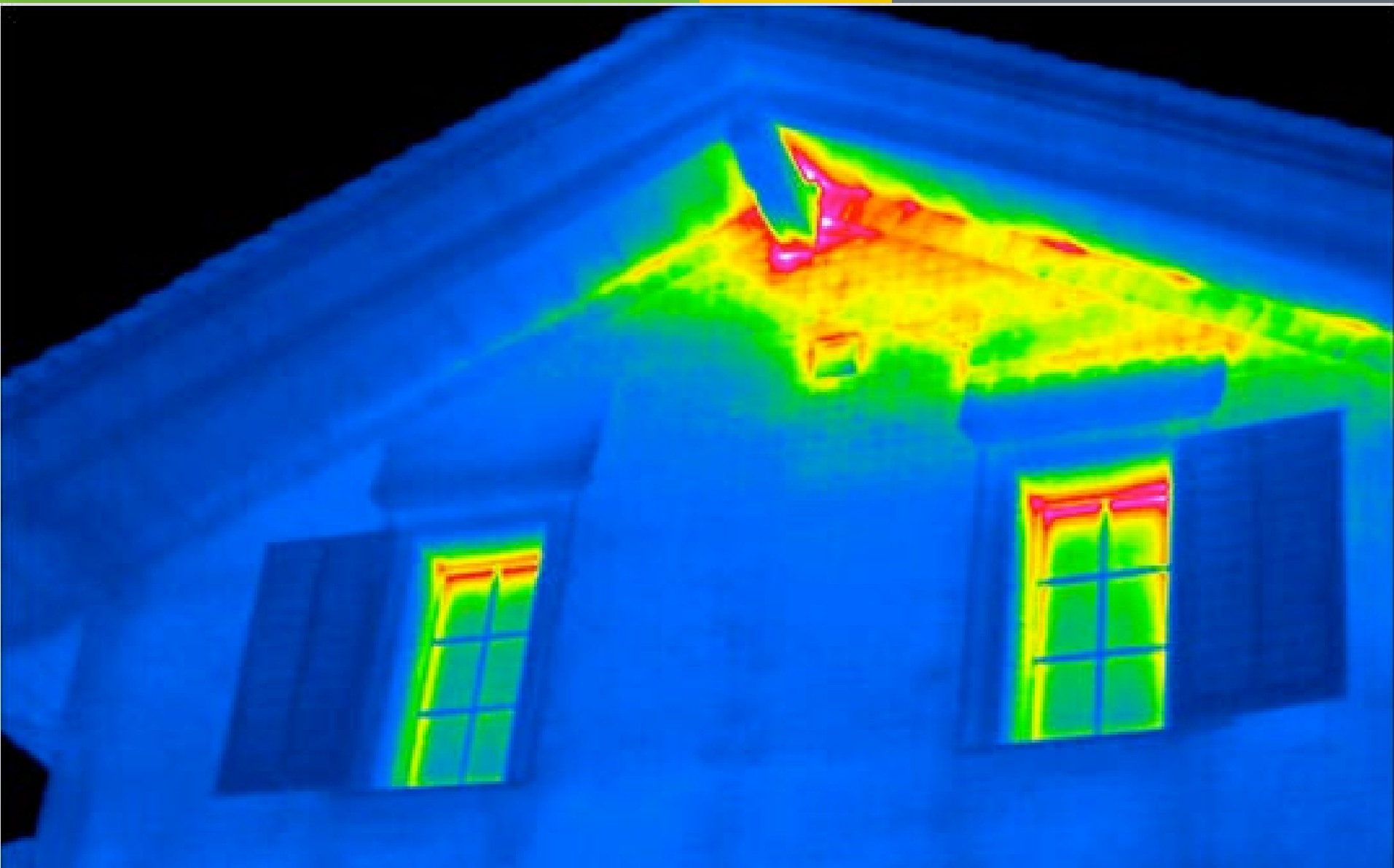
Through the Greenest City Action Plan, we are aiming to reduce emissions from existing buildings by 20% by 2020. This would eliminate 160,000 tonnes of GHGs per year - the equivalent of removing 40,000 cars from the road.



# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

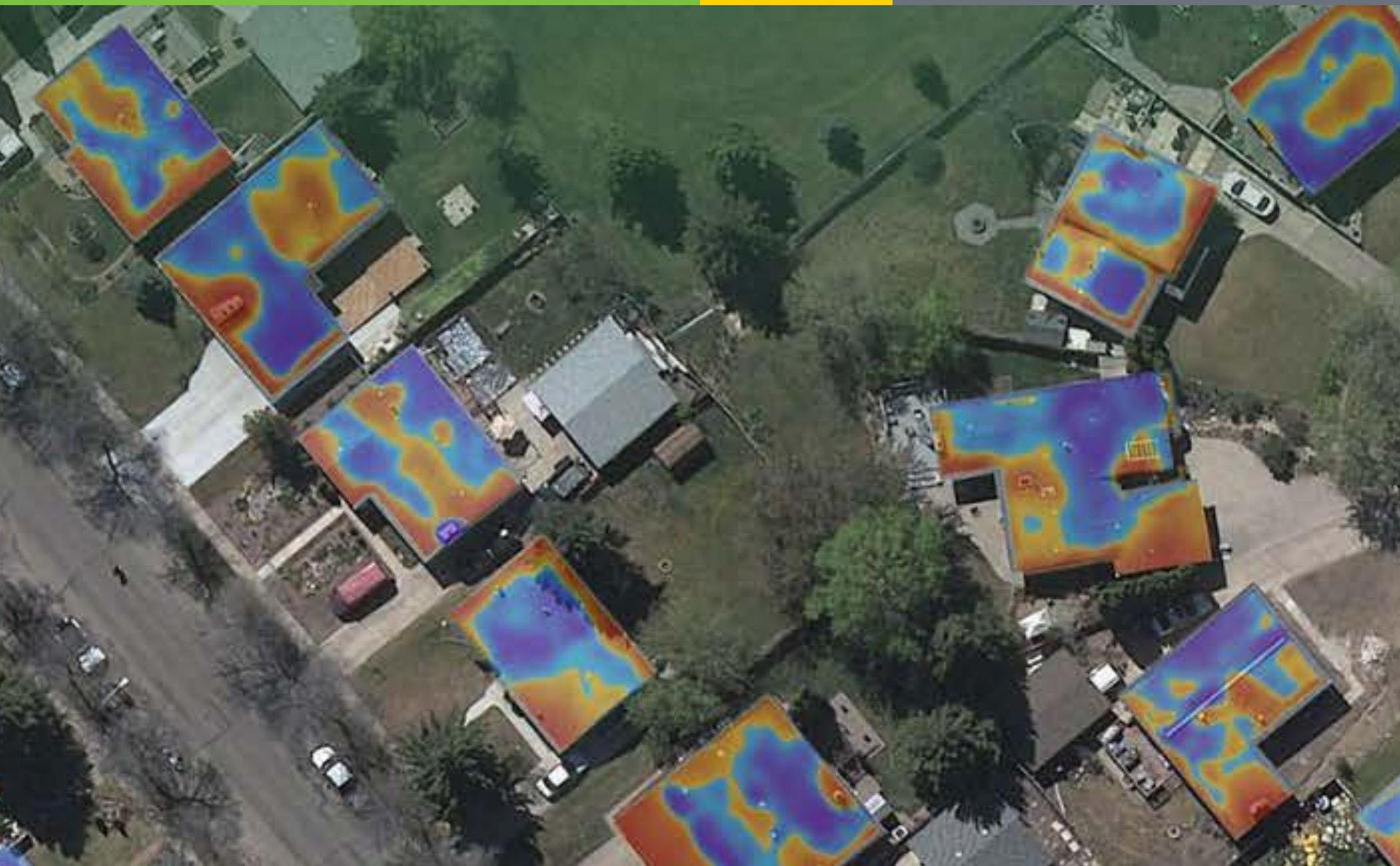




# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

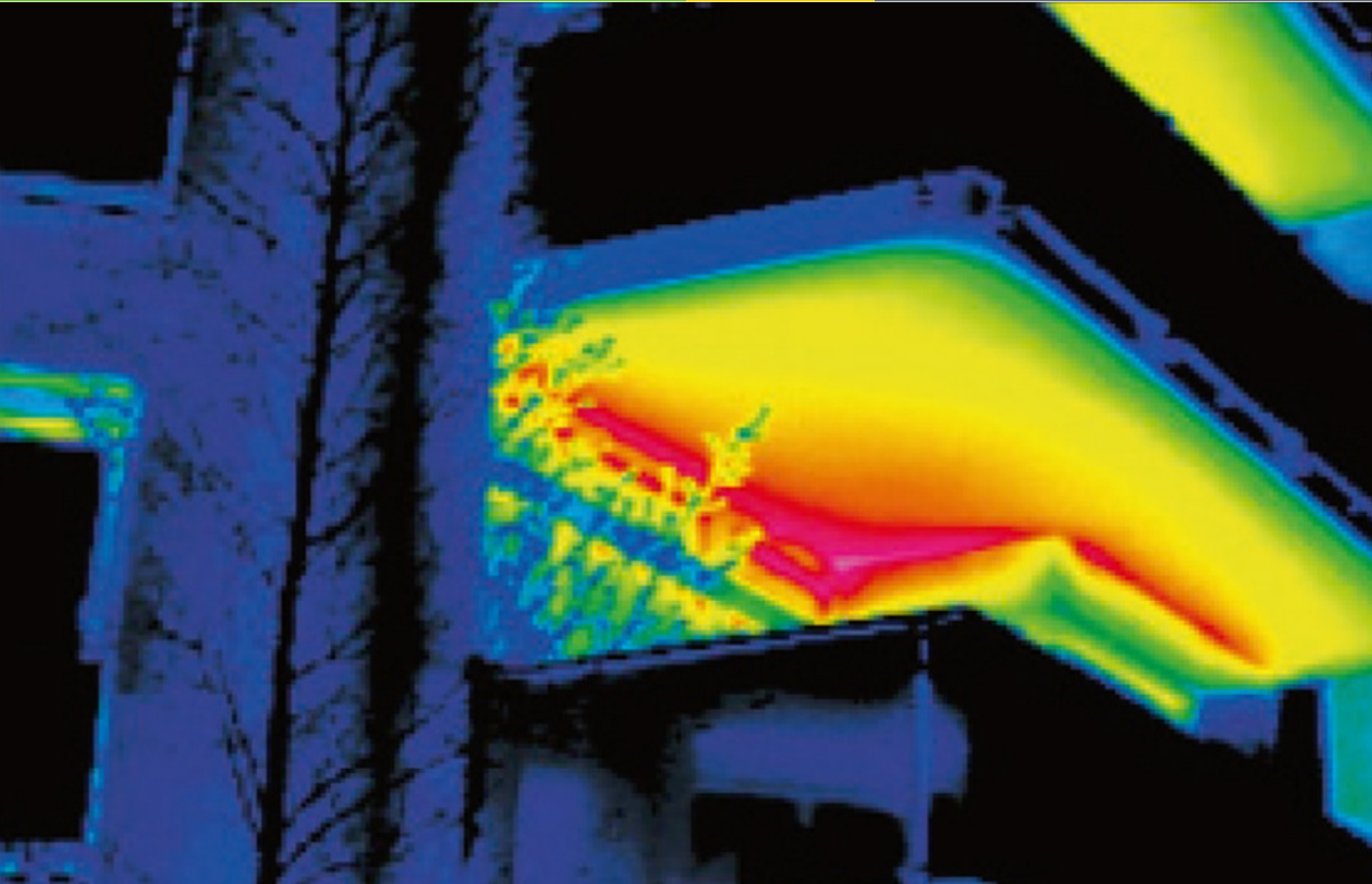
Energy Efficiency &  
Renewable Energy



# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

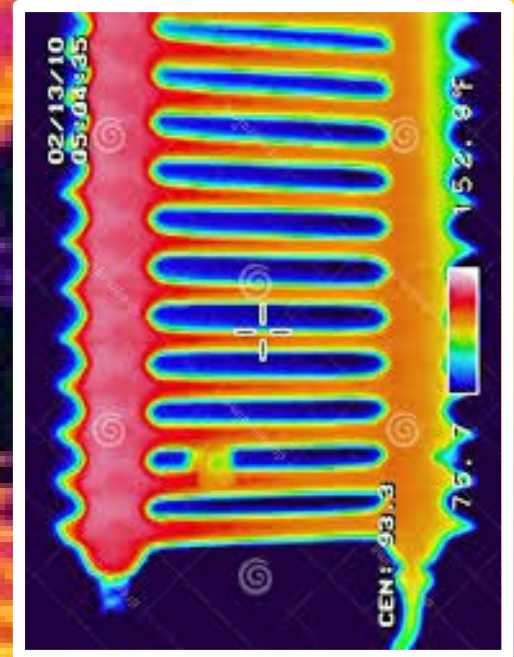


Aqua in Chicago

# Buyers Will Know Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Aqua in Chicago



# Builders Compete Thermal Defects

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Call Us: (801) 298-8881



[Why Haskell Homes](#)

[Home Designs](#)

[Communities](#)

[Video Library](#)

[Contact Us](#)

[Blog](#)



## Benefits of the GreenLean construction process

Based on the government's EnergyStar program, Haskell Homes has developed an exclusive new Green Lean construction process (patent pending) that catapults our homes to much higher levels of energy efficiency and green building than even the EPA suggests.

Competitor's  
Home



Click to enlarge

Thermal imaging can detect where homes are losing energy. In this picture of one of our major competitors houses the light areas represent heat loss during the winter. As you can see, heat is escaping from every board in the framing. This is due to the way the home was built, how it is insulated and several other factors. Haskell Homes built using the GreenLean construction method lose much less heat than what is being shown here. Because of GreenLean, every Haskell Home is able to save you as much as 50% on your utility costs. This translates to more money in your pocket each and every month you live in your home.

Our  
Home



Click to enlarge

This is a thermal image of a Haskell Home. As you can see, there is no heat loss from the framing inside the walls as there is in the picture of our competitor's house above. This is due to the GreenLean construction process which includes staggered 2 x 6 framing vs. standard 2 x 4 framing. It is also due to the better insulation used as well as many other unique construction techniques and attention to detail that make every Haskell Home have an HERS energy efficiency rating of 65 or less vs. a rating of 80 or above for many of our competitors' homes. Call us today at 801-298-8881 to learn more!

### Home Designs

Choose from 16 beautifully designed homes

[View Plans](#)

### Locations

Build on your lot or ours across the Wasatch Front

[View Locations](#)

...because it minimizes the risk of  
**Thermal Defects**

# Buyers Will Know Poor Windows

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Buyers Will Know Poor Windows

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Buyers Will Know Good Windows

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



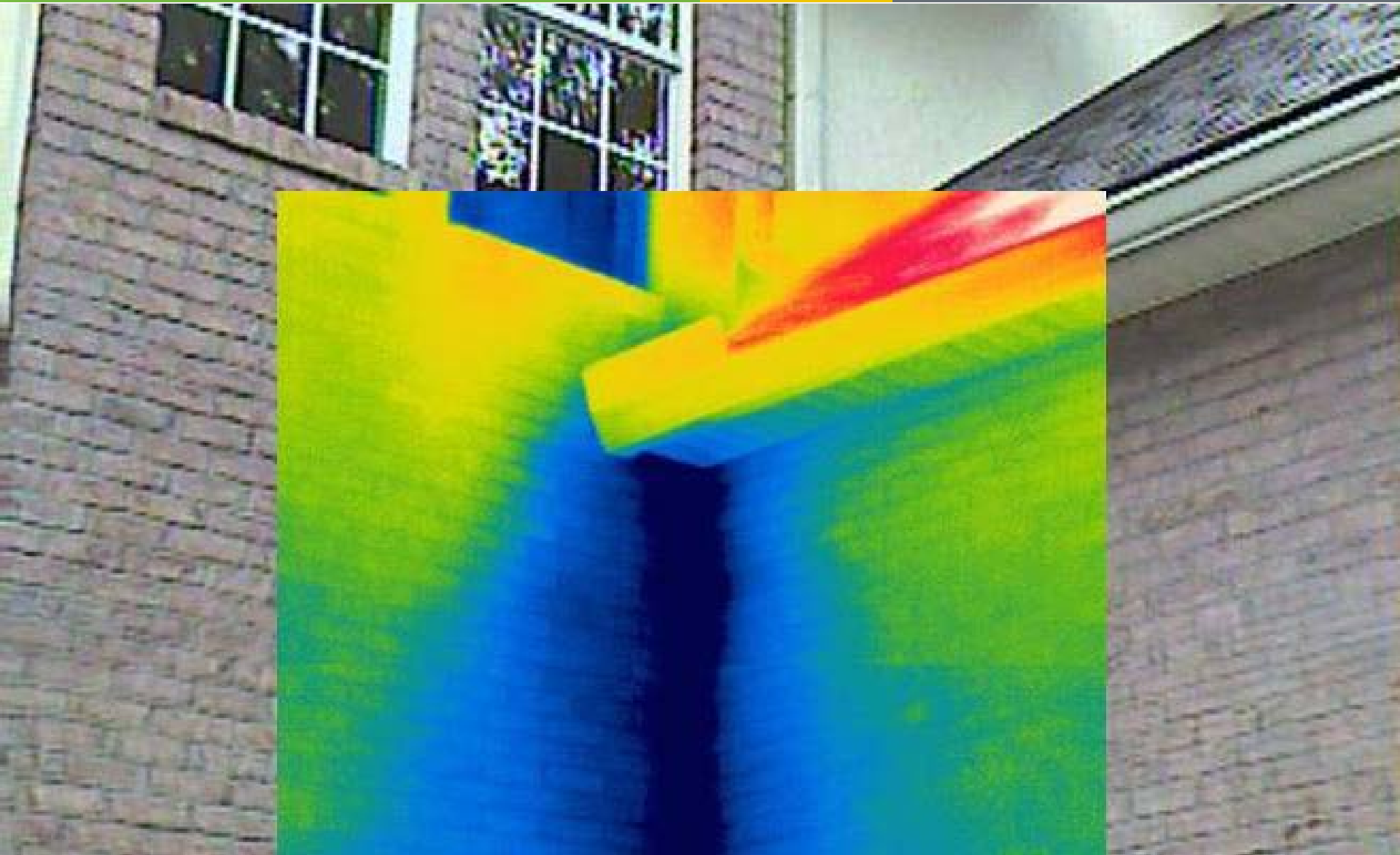
...because it integrates

**Advanced  
Windows**

# Buyers Will Know Moisture Problems

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Buyers Will Know Moisture Problems

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





...because it minimizes the risk of  
**Moisture Defects**

## Diagnostic System:

- **Six Sensors**  
[Outdoor Condenser]
  - 3 Thermal
  - 2 Voltage
  - 1 Current
- **<15 Minutes Install**
- **\$50 Hardware**



### Current RMS Configuration

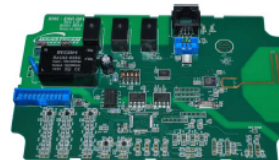
AP & ED Total Cost \$95



End Device (ED)



Access Point (AP)



New Configuration: Direct Internet Connection – Total Cost < \$50

## Diagnostic Capability:

- **Charge** [Low]
- **Capacitor** [Failed Start or Run]
- **Flow** [Condenser or Evaporator]
- **Operation** [Normal/Abnormal]
- **Performance** [COP]

# Buyers Will Know HVAC Quality



# Buyers Will Know HVAC Quality



...because it helps ensure  
**Quality HVAC**

## **Indoor vs. Outdoor Air Pollutants:**

On average **2-5 times greater**

Up to **100 times greater**

While Americans Spend

**90% of time indoors**

Source: EPA

“If your child doesn’t use an inhaler,  
consider yourself a lucky parent because,

**1 in 10 children in the U.S.  
suffers from asthma.”**

Source: Remarks for Administrator McCarthy, Announcement of Clean Power Plan,  
Washington, DC, June 2, 2014



# Buyers Will Know Indoor Air Quality



# Buyers Will Know Indoor Air Quality

 Air Mentor

2015-02-05 10:10:53

 Air Mentor



Particulate Matter **Good**

<5

Temperature **Good**

20.4 °C ✓

Gas Pollution **Moderate**

511 ↑

Humidity **Good**

53 % ✓

PM2.5 **Good**

<5

Current status:

The last hour average value  
is 5 ug/m3.



Recommendation Actions:

## African Violet

African Violet will bloom throughout the year, and it has strong ability to reduce carbon dioxide and hold dust. It reduces carbon dioxide concentrations i...

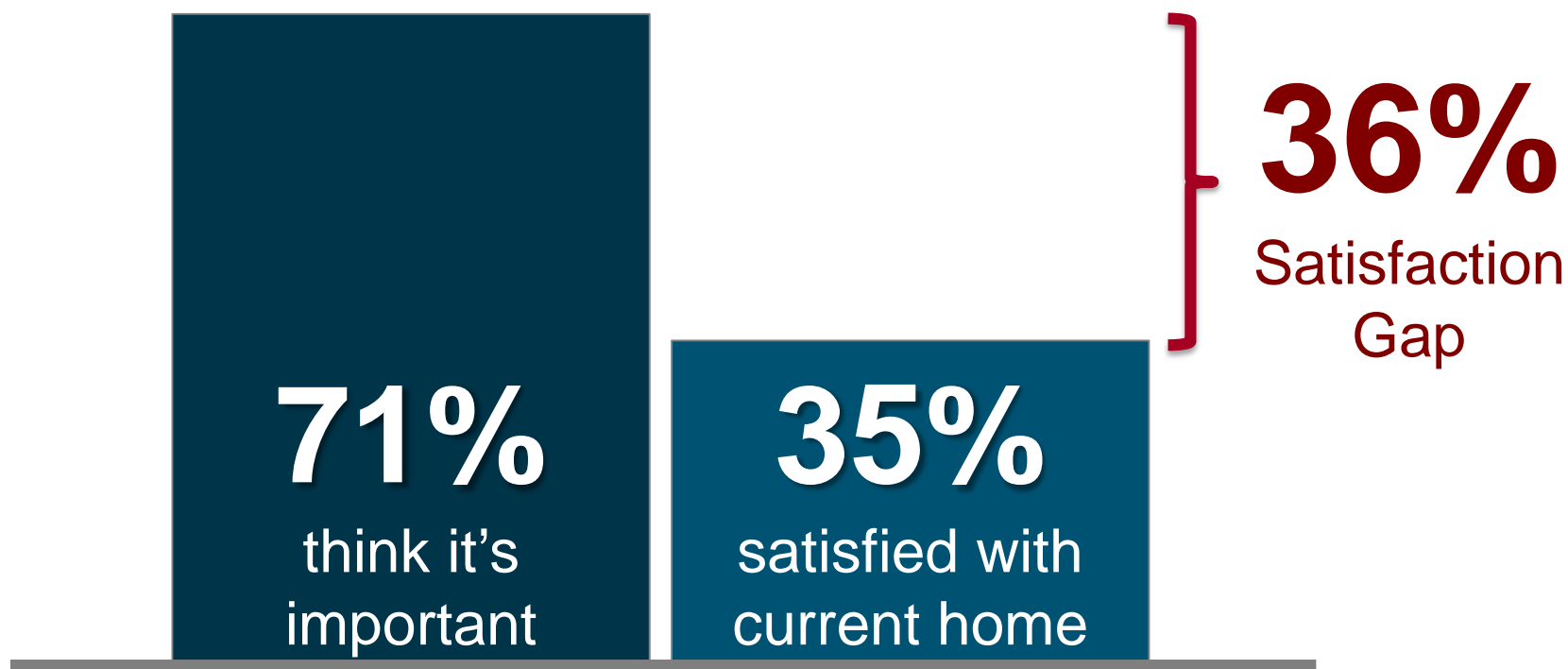


Effects

PM 

CO2 

...because it helps minimizes the risk of  
**Health Problems**



“very energy efficient with low monthly utility costs.”

**Source:** *The Housing Satisfaction Gap: What People Want but Don't Have*, Demand Institute, 2014

# Buyers Will Know Operational Score

U.S. DEPARTMENT OF  
**ENERGY**

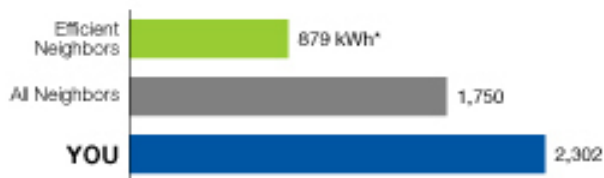
Energy Efficiency &  
Renewable Energy



## Last Summer Comparison

You used **32% MORE** electricity than your neighbors.

Your usage last summer: May '10 – Sep '10



\* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

### Who are your Neighbors?

**All Neighbors:** Approximately 100 occupied, nearby homes that are similar in size to yours (avg 1,362 sq ft)

**Efficient Neighbors:** The most efficient 20 percent from the "All Neighbors" group

Great 😊😊

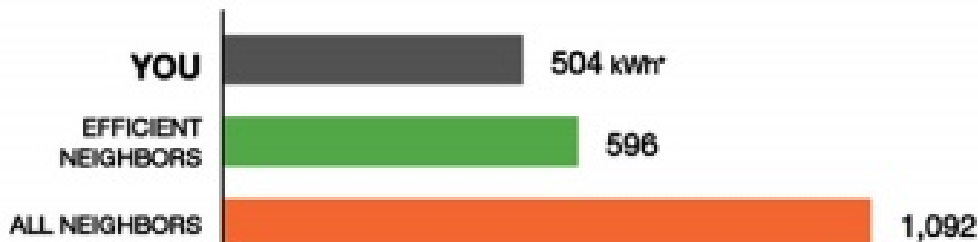
Good 😊



**BELOW AVERAGE**

## Last Month Neighborhood Comparison

Last month you used **15% LESS** electricity than your efficient neighbors.



\* kWh: A 100-Watt bulb burning for 10 hours uses 1 kilowatt-hour.

YOUR EFFICIENCY STANDING:

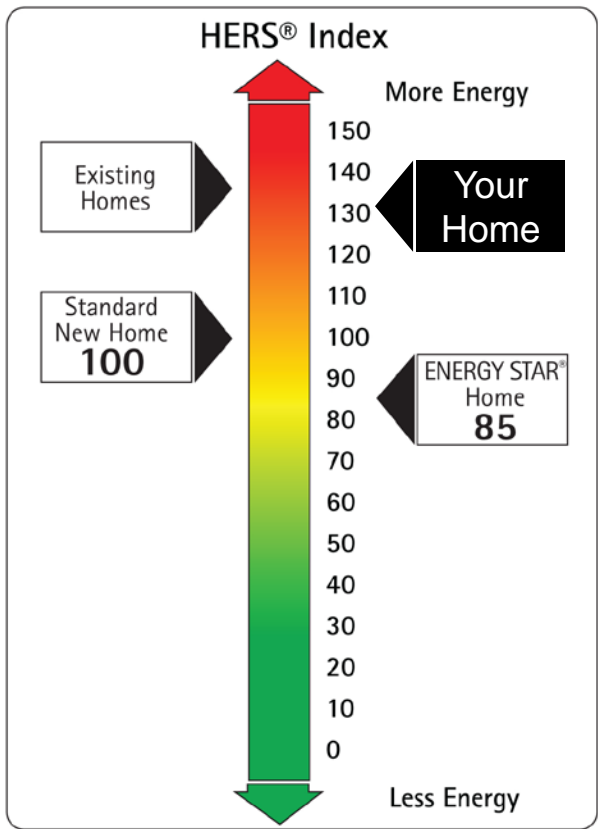
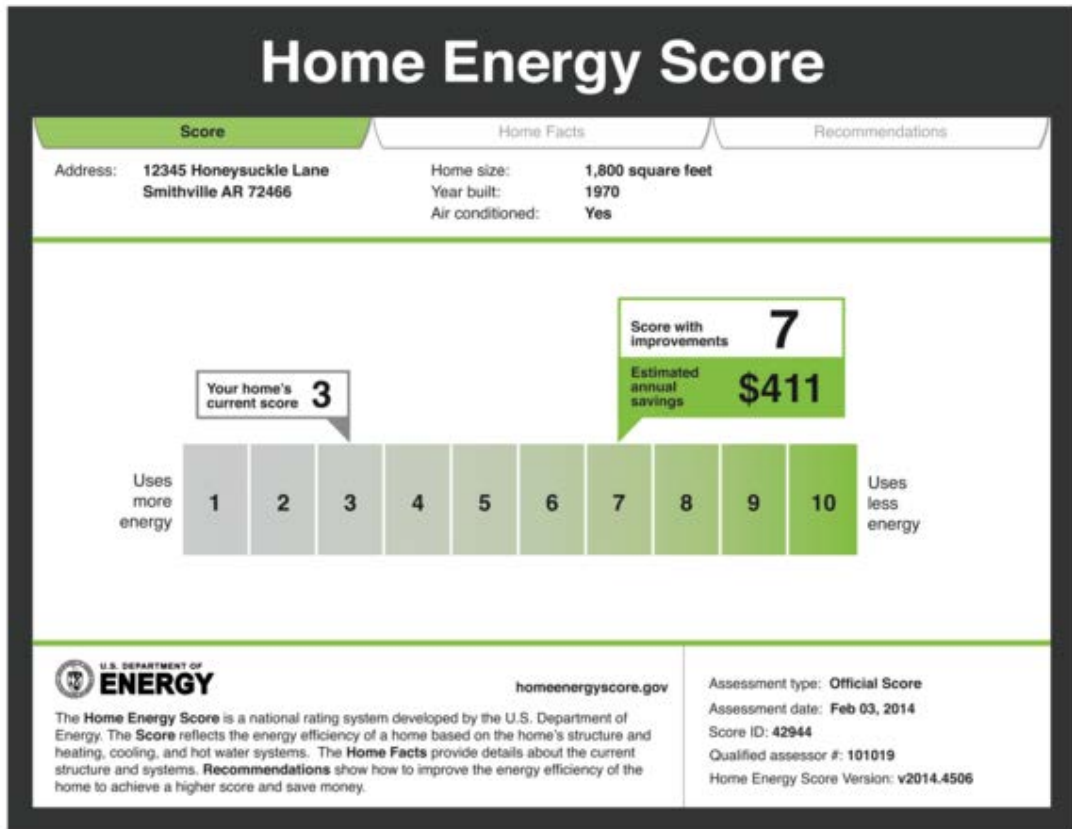


**GREAT** 😊😊

GOOD 😊

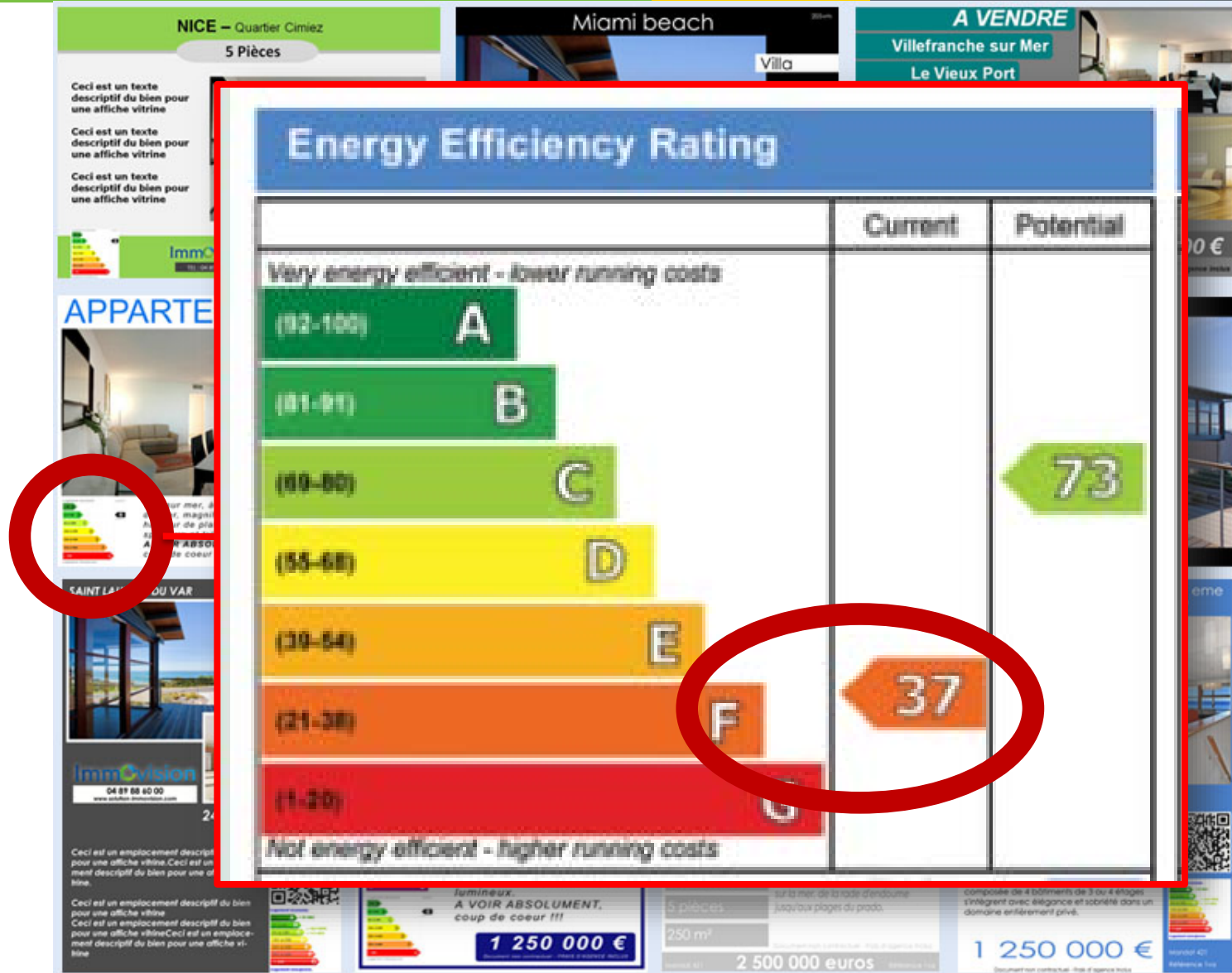
BELOW AVERAGE

# Buyers Will Know Asset Score



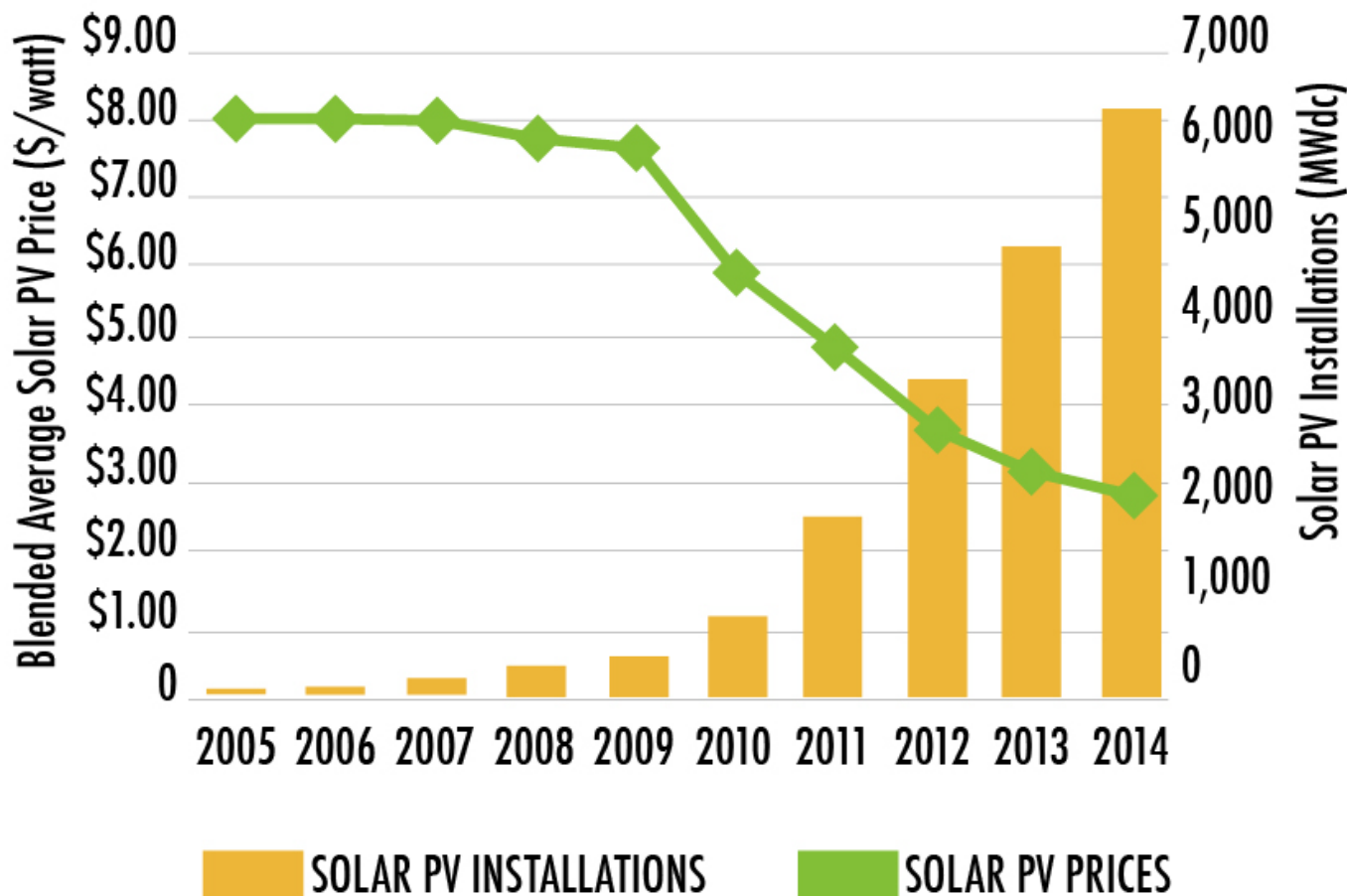


# Buyers Will Know Efficiency



...because it optimizes  
**Energy Efficiency**

# Buyers Know Solar Prices Falling



Source: “Solar Adds More Than 4 Gigawatts of Capacity in Q3, Marking its Largest Quarter in History, U.S. Solar Market Insight,” Solar Energy Industry Association, Updated Dec. 13, 2016



# Buyers Can See Solar

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



...because it optimizes

# Solar Readiness



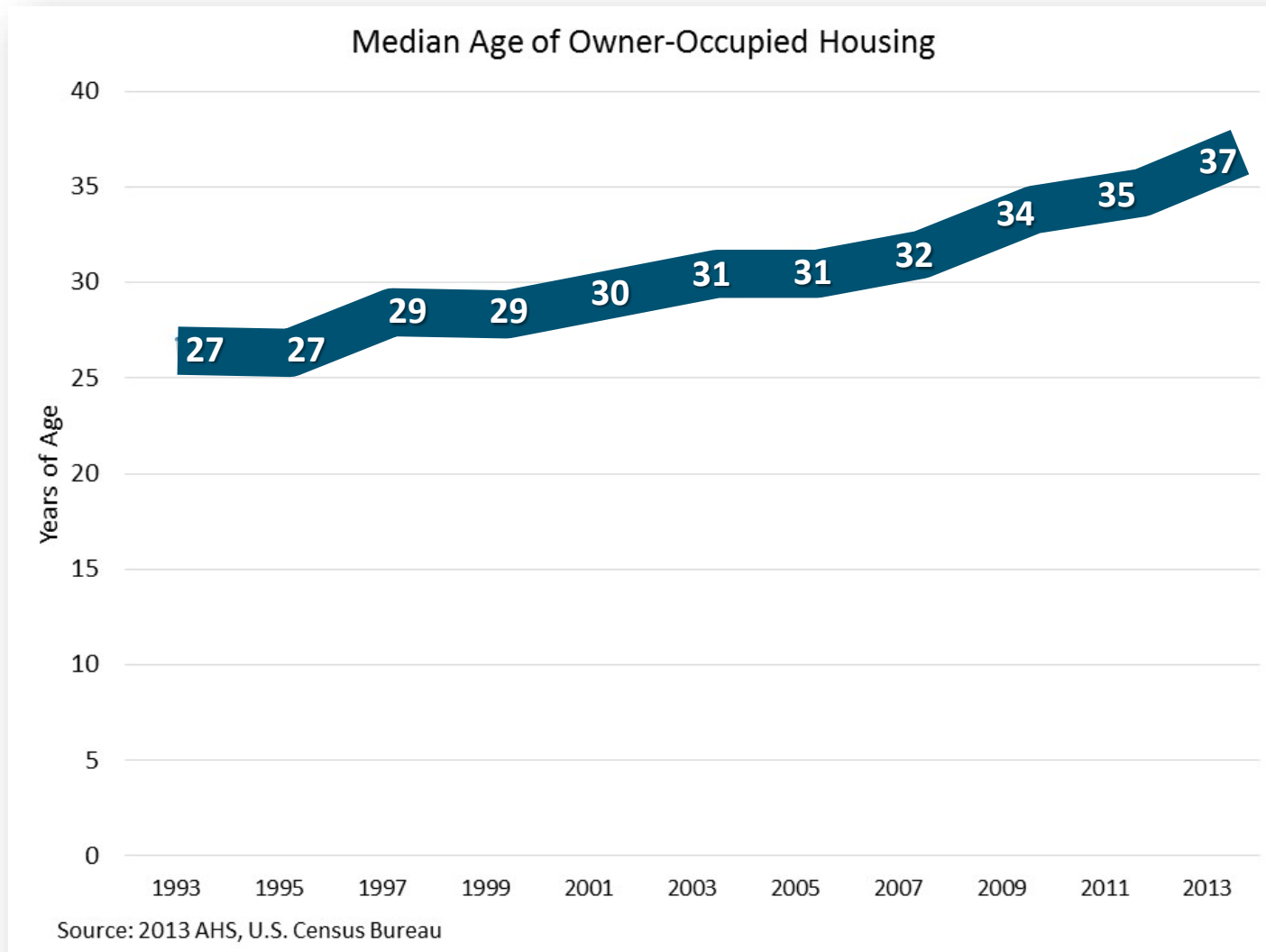
# Buyers Know Planet is Hurting





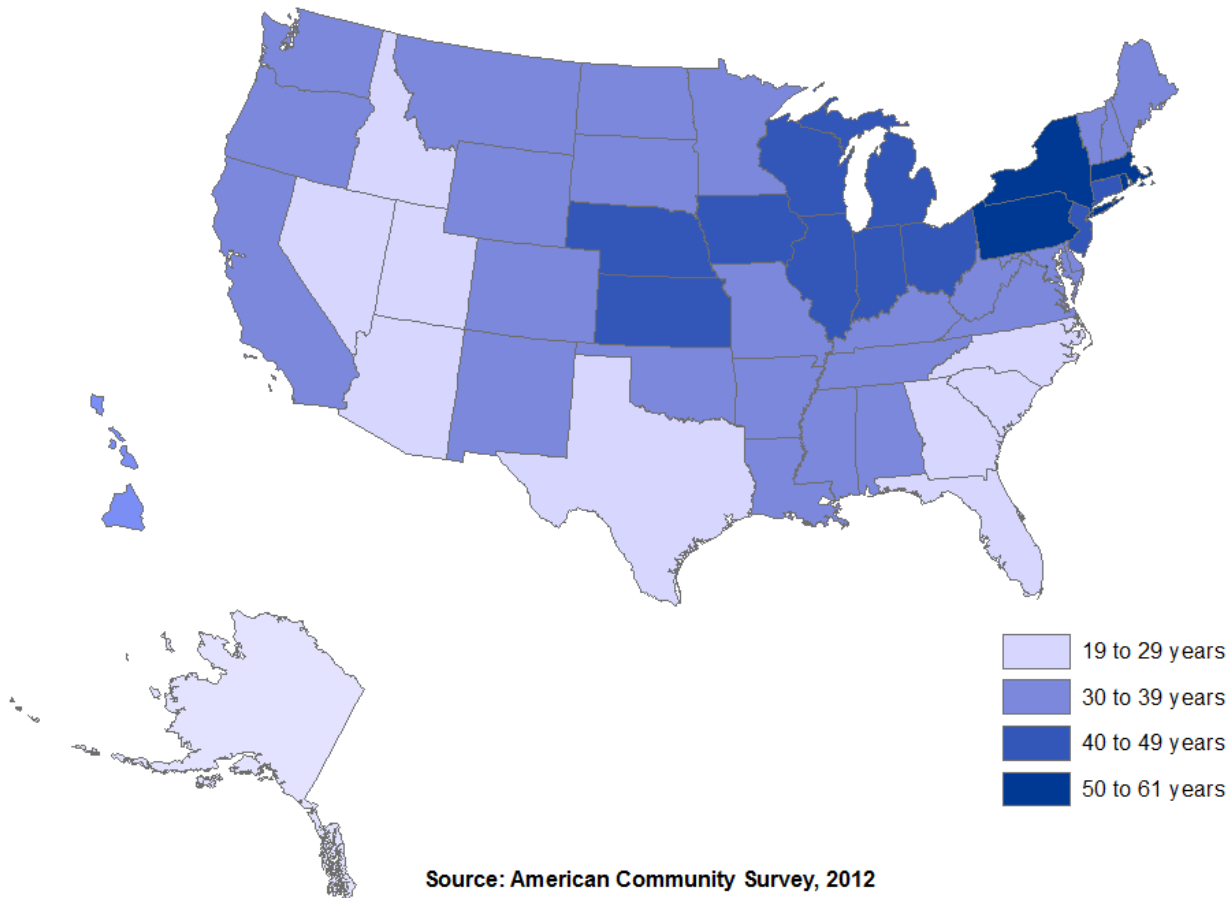
...because it minimizes  
**Environmental  
Impact**

# Buyers Know Homes Are Aging



# Buyers Know Homes Are Aging

**Median Age of Housing Stock**



- High Utility Bills
- Poor Comfort
- Health Concerns
- Moisture Issues
- Excessive Bugs/Pests
- Durability Problems
- Obsolete Technology



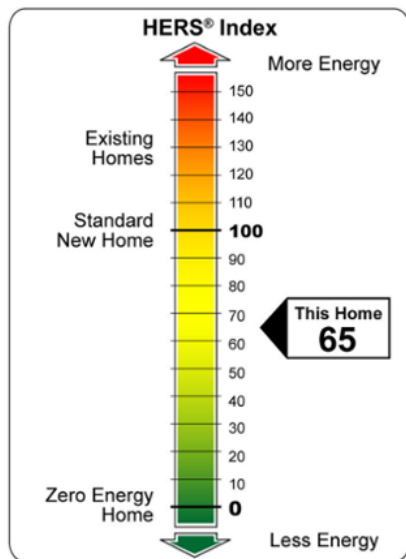
**Meet  
85%  
of Your  
Competition**

...because it eliminates many liabilities with  
**Older Homes**

# Buyers Know Trusted Performance

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Buyers Know Trusted Performance

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



...because it delivers  
**Trusted  
Performance**

# Buyers Will Know Reviews



**Gary Lanthrum** reviewed Estes Builders — **5★**

March 22 at 1:56pm · 🌐

This is the third house I've had built. Working with Estes was by far the best experience of all these construction projects. All new home construction projects will experience unexpected problems and challenges along the way. What really set Estes apart was the efficient and equitable way they help us work through those inevitable problems as they arose. Add to that the craftsmanship of the subs they used and we're all smiles with our new home.



Like



Com



Estes Builders

## Home Builders - DO NOT BUILD WITH THIS COMPANY!!!

Jun 30 [redacted] Home Construction and Repair [redacted] Unprofessional Builder 428  
REVIEW RATING 5/5

If you are thinking about building with this company, I beg you not to. We signed a contract a year ago and were told that we would have a home in January. Well, January has come and gone and we just now have a completed home as of last week... Except when you walk inside you see missing trim, broken windows, the vinyl siding is warped, the porch steps are about to split apart, the paint looks... [Read more >](#)

Was this review helpful? 6 ↑ 1 ↓

## Home Builders - Horrible Experience

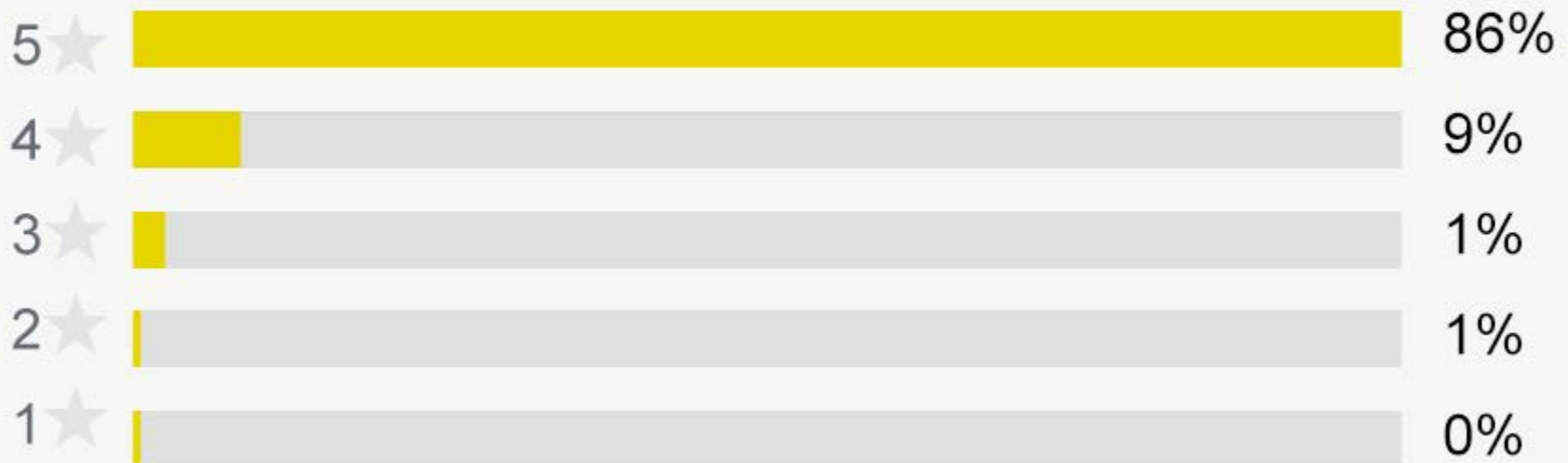
May 31 [redacted] Home Construction and Repair [redacted] Home Construction 391 REVIEW RATING 5/5

First off I cant even describe how frustrating this was for me and my family. This company is just full of excuses. A 4 month home build turned into a year and a half. This company uses the bottom of the barrel subcontractors. I can write a book about how crapy the builder and the company is. They string you along the whole time thinking your an \*\*\*. The regional manager [redacted] ... [Read more >](#)

Was this review helpful? 7 ↑ 0 ↓

## Coming to a housing industry near you...

4.8 out of 5 stars



from 8.8 million customer reviews

...because it helps optimize the  
**Home Living  
Experience**

1. If it can be done, it ***will*** be done.
2. If you don't do it, ***someone else*** will.

\* Daniel Burrus, ***"Flash Foresight"***



- **Film:**
  - Kodak
  - Polaroid
- **Communication:**
  - Motorola
  - Palm
- **Retail**
  - Too Many Retailers to Name
- **Transportation:**
  - American Car Manufacturers (close call)
  - TWA and other Legacy Airlines
  - Taxis

... and the list goes on...

## ...for Transformational Experiences:

Personal  
Transportation



<1X

# Informed Buyers Willing to Pay...

## ...for Transformational Experiences:

Personal  
Transportation



Daily  
Break



**<1X**

**2-3X**

# Informed Buyers Willing to Pay...

## ...for Transformational Experiences:

Personal  
Transportation



**<1X**

Daily  
Break



**2-3X**

Healthy  
Food



**2-3X**

# Informed Buyers Willing to Pay...

## ...for Transformational Experiences:

Personal  
Transportation



**<1X**

Daily  
Break



**2-3X**

Healthy  
Food



**2-3X**

Tech +  
Design



**10X**



# Informed Buyers Willing to Pay...

## ...for Transformational Experiences:

Personal  
Transportation



<1X

Daily  
Break



2-3X

Healthy  
Food



2-3X

Tech +  
Design



10X

Healthy  
Water



∞X





# Zero Energy Ready Home Training

## **Zero Value Translated**

# Zero Communication Challenge

## How do consumers decide?

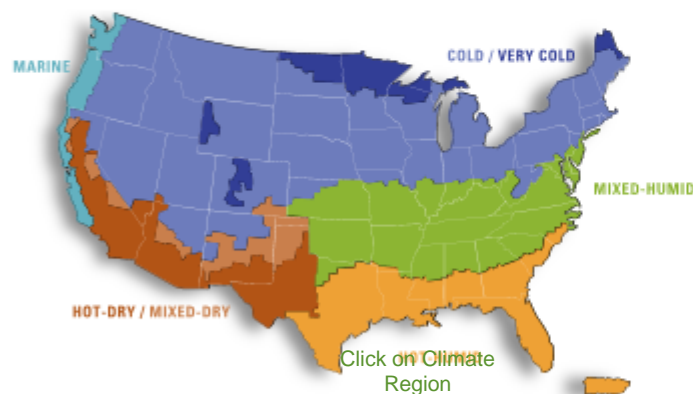


- **Simple** Core Message
- **Showcase** Better Experience
- **Clarity** with Contrast

# Simple: Consumer Video

[Home](#) » [Residential Buildings](#) » [Zero Energy Ready Home](#) » DOE Tour of Zero

Are you ready for a home that lives, works, and lasts better? The home of the future - [a better home](#) - is available today. Take a virtual tour of homes that are so energy efficient a renewable energy system can offset all or most of their annual energy consumption. These award-winning homes are independently certified to meet DOE Zero Energy Ready Home [guidelines](#) and constructed by a select group of [top builders](#). Zero Energy Ready Home is part of the U.S. Department of Energy's Better Buildings initiative. Better Buildings aims to make commercial, industrial, public, and residential buildings 20 percent more energy efficient over the next decade.



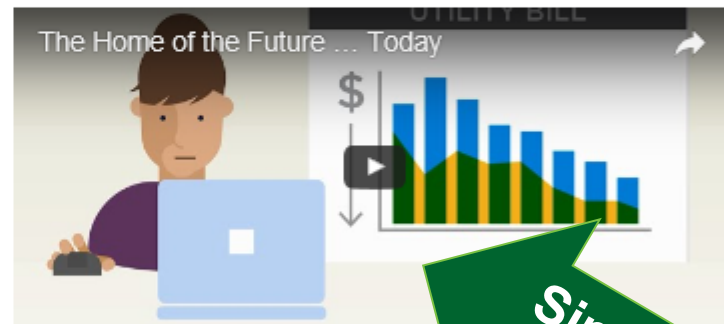
Click on a climate zone to see homes in that region.

Search:

SEARCH

RESET

Showing 1 to 25 of 123 entries



[The Home of the Future Today Video](#) [Next Video](#)

Simple Core  
Message

Show

25



entries

# Simple: Consumer Video



The home of the future...  
**Today**



Buying a home is often the largest purchase of a lifetime with so much riding on getting it right.





This is because it's often cost-prohibitive to make substantial changes once a home is built.



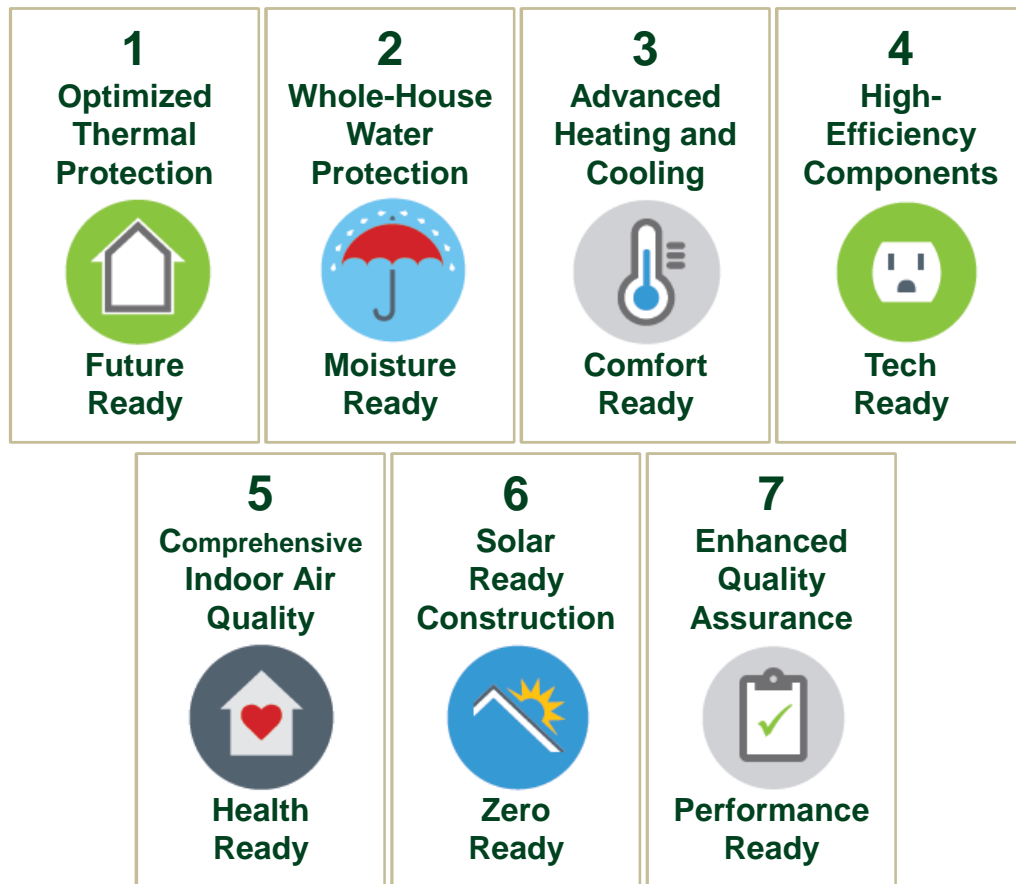
Wouldn't it be great  
to know what  
**leading experts**  
would look for in a  
new home  
that performs  
to their expectations?



**Well now you do.**

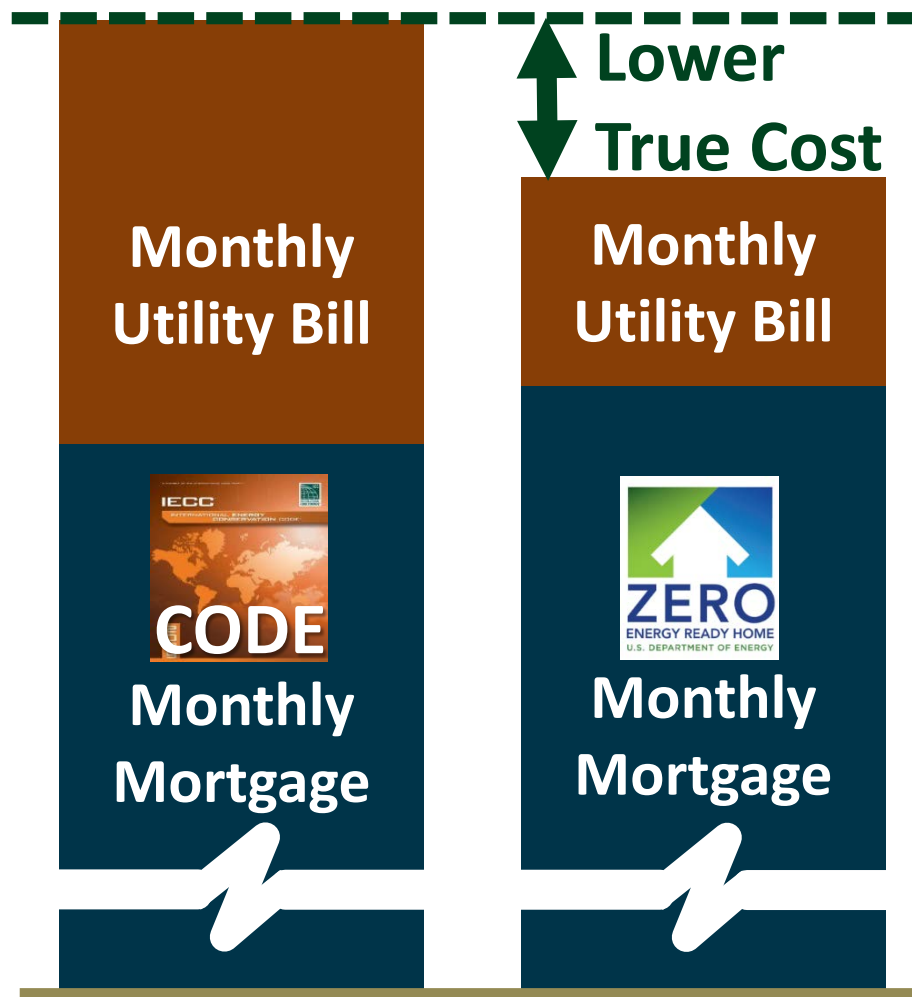
When building performance professionals are polled, they overwhelmingly choose homes that meet Department of Energy Zero Energy Ready Home specifications.

## Seven Must-Have Systems



That's because leading experts know every certified Zero Energy Ready Home includes **seven must-have systems** that help ensure a superior homeowner experience.

# Simple: Consumer Video



Maybe most significantly, leading experts know all this **added value**, compared to a minimum code home, is available for **lower ownership cost** where significant utility bill savings exceed additional mortgage expenses.



In other words,  
leading experts know  
**buying smart**  
is as easy as looking  
for the DOE Zero  
Energy Ready Home  
label.





## Zero Energy Ready Home **for More Information:**

<https://energy.gov/eere/buildings/zero-energy-ready-home-homebuyers>

For more information  
how you can get the  
home experts would  
choose, visit the Zero  
Energy Ready Home  
web site.

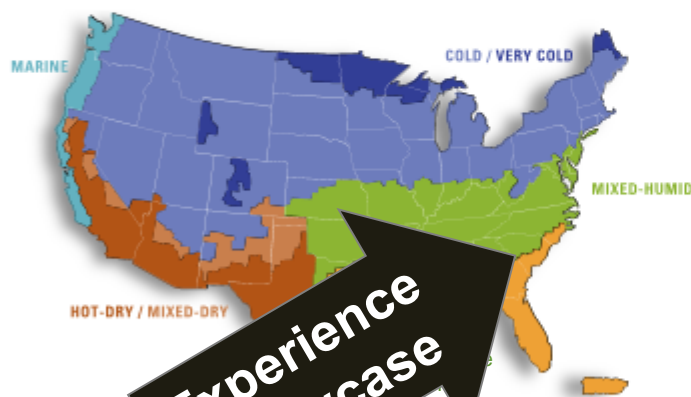
## Housing Innovation Awards Feeds Tour of Zero



# Showcase: Tour of Zero

[Home](#) » [Residential Buildings](#) » [Zero Energy Ready Home](#) » DOE Tour of Zero

Are you ready for a home that lives, works, and lasts better? The home of the future - [a better home](#) - is available today. Take a virtual tour of homes that are so energy efficient a renewable energy system can offset all or most of their annual energy consumption. These award-winning homes are independently certified to meet DOE Zero Energy Ready Home [guidelines](#) and constructed by a select group of [top builders](#). Zero Energy Ready Home is part of the U.S. Department of Energy's Better Buildings initiative. Better Buildings aims to make commercial, industrial, public, and residential buildings 20 percent more energy efficient over the next decade.



Click on a climate zone to view homes in that region.

Search:

SEARCH

RESET

Showing 1 to 25 of 123 entries



[The Home of the Future Today Video \(Text Version\)](#)

Show

25



entries

# Showcase: Tour of Zero

Search:

Showing 1 to 13 of 13 entries (filtered from 123 total entries)

Show    
entries

TOUR THESE HOMES ▲	BUILDER ▲	LOCATION ⬆	HIA WINNER ⬆	CLIMATE ZONE ⬆
<a href="#">Air Park Drive</a>	<a href="#">Addison Homes</a>	Greer, SC	2016 HM	MIXED-HUMID
<a href="#">Cobbler Lane</a>	<a href="#">Addison Homes</a>	Greer, SC	2015	MIXED-HUMID
<a href="#">Invision Zero Home</a>	<a href="#">Addison Homes</a>	Greer, SC	2016	MIXED-HUMID
<a href="#">The Emery</a>	<a href="#">Addison Homes</a>	Greer, SC	2016	MIXED-HUMID
<a href="#">Friendly Home</a>	<a href="#">Ferguson Design &amp; Construction Inc.</a>	Sagaponack, NY	2013	MIXED-HUMID
<a href="#">Julia Plan</a>	<a href="#">Habitat for Humanity of Catawba Valley</a>	Hickory, NC	2016	MIXED-HUMID
<a href="#">Villas at Rocketts Landing</a>	<a href="#">Health E Community Enterprises of Virginia</a>	Williamsburg, VA	2016	MIXED-HUMID
<a href="#">Euclid Avenue</a>	<a href="#">Heirloom Design Build</a>	Atlanta, GA	2015	MIXED-HUMID
<a href="#">High-Performance Bungalow</a>	<a href="#">Imery &amp; Co.</a>	Athens, GA	2016	MIXED-HUMID
<a href="#">EXIT-O House</a>	<a href="#">John Hubert Associates</a>	Wyncote, PA	2014	MIXED-HUMID
<a href="#">Charlottesville Infill</a>	<a href="#">Promethean Homes</a>	Steeles Tavern, VA	2014	MIXED-HUMID
<a href="#">First DOE Zero Energy Ready Manufactured Home</a>	<a href="#">Southern Energy Homes</a>	Russellville, AL	2014	MIXED-HUMID
<a href="#">Proud Green Home</a>	<a href="#">The Imery Group</a>	Athens, GA	2014	MIXED-HUMID

## DOE Tour of Zero: The Emery by Addison Homes

[Home](#) » DOE Tour of Zero: The Emery by Addison Homes



"THE DOE ZERO ENERGY READY HOME PROGRAM HAS SET A STANDARD THAT IS TRULY 'BEST IN CLASS' AND IS PULLING OUR INDUSTRY TOWARD A QUALITY REVOLUTION."

**Consumer  
Experience**



## DOE Tour of Zero: The Emery by Addison Homes

[Home](#) » DOE Tour of Zero: The Emery by Addison Homes



**"THE DOE ZERO ENERGY READY HOME PROGRAM HAS SET A STANDARD THAT IS TRULY  
'BEST IN CLASS' AND IS PULLING OUR INDUSTRY TOWARD A QUALITY REVOLUTION."**



## DOE Tour of Zero: The Emery by Addison Homes

[Home](#) » DOE Tour of Zero: The Emery by Addison Homes



**"THE DOE ZERO ENERGY READY HOME PROGRAM HAS SET A STANDARD THAT IS TRULY  
'BEST IN CLASS' AND IS PULLING OUR INDUSTRY TOWARD A QUALITY REVOLUTION."**

## DOE Tour of Zero: The Emery by Addison Homes

[Home](#) » DOE Tour of Zero: The Emery by Addison Homes



**"THE DOE ZERO ENERGY READY HOME PROGRAM HAS SET A STANDARD THAT IS TRULY 'BEST IN CLASS' AND IS PULLING OUR INDUSTRY TOWARD A QUALITY REVOLUTION."**

# Showcase: Tour of Zero

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

**"THE DOE ZERO ENERGY READY HOME PROGRAM HAS SET A STANDARD THAT IS TRULY 'BEST IN CLASS' AND IS PULLING OUR INDUSTRY TOWARD A QUALITY REVOLUTION."**

## DOE Zero Energy Ready Home: Partner Profile

Addison Homes, LLC



Partner ID: 549  
Organization Type: Builder  
Main Contact: Todd Usher  
Address: 16 PARKWAY COMMONS WAY  
GREER, SC 29650  
(864) 848-2667  
Primary Phone Number: (864) 848-2667  
Certified DOE Zero Energy Ready Homes (2012 - Present): 5  
Certified Builders Challenge Homes (2008 - 2012): 2  
Website: [www.addison-homes.com](http://www.addison-homes.com)  
HIA Winner: 2015, 2016, 2016, 2016



- High-efficiency
- High-efficiency advanced lighting technology
- energy and water savings

[Read more.](#)



mer  
ence

Insulation system



Addison Homes  
Emergy

Key  
Stats

Contact  
Info

Innovations  
(Power Words)

4,551 ft<sup>2</sup>  
3 bedrm, 2 bath  
1 floor  
3A mixed-humid  
custom for buyer

HERS 21 This home's  
score w/PV

0 = a net zero energy home  
100 = typical new code home  
130 = average existing home

Avg. Monthly Energy Bill:

\$71

Calculated vs. 2009 IECC home

Annual Savings:

\$2,412

Calculated vs. 2009 IECC home

30-yr Mortgage Savings:

\$125,500+

Calculated with fuel escalation rate  
per 2014 EIA Annual Energy Outlook

## Goal:

Inspire consumers  
to visit the home of the future...  
available today...  
DOE Zero Energy Ready Homes.

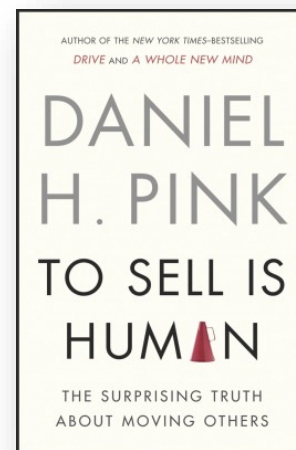
## Innovation Partners:

- Manufacturers
- Associations
- Utilities
- Lenders



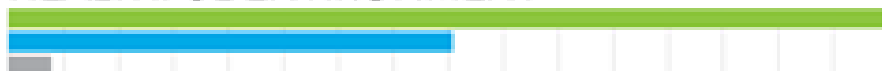
## Clarity depends on contrast.

We often understand something better  
when we see it in comparison  
with something else  
than when we see it in isolation.

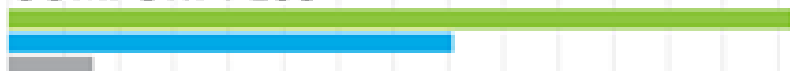


# Clarity: ZERH Comparison Bars

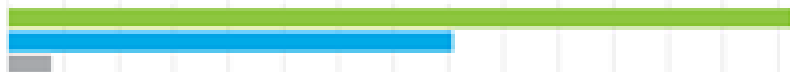
## HEALTHFUL ENVIRONMENT



## COMFORT PLUS



## ADVANCED TECHNOLOGY



## ULTRA EFFICIENT



## QUALITY BUILT



## DURABILITY



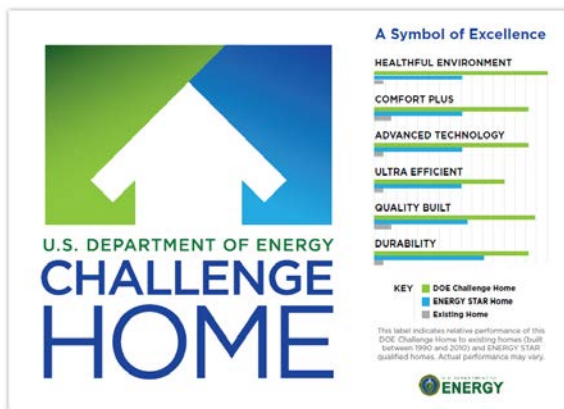
### Key:

- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home



## DOE Challenge Home Label Methodology

October 2012



DOE Challenge Home  
Label Methodology

October 2012

1

## Homes to the Power of **ZERO**



### What is the DOE Zero Energy Ready Home™ Label?

It is a Symbol of Excellence for energy savings, comfort, health, quality, and durability met by a select group of leading builders meeting U.S. Department of Energy Guidelines.

### What is a Zero Energy Ready Home?

It is a high-performance home so energy efficient, all or most annual energy consumption can be offset with renewable energy. In other words, it is the Home of the Future.

### A Symbol of Excellence

#### HEALTHFUL ENVIRONMENT



#### COMFORT PLUS



#### ADVANCED TECHNOLOGY



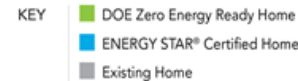
#### ULTRA EFFICIENT



#### QUALITY BUILT



#### DURABILITY

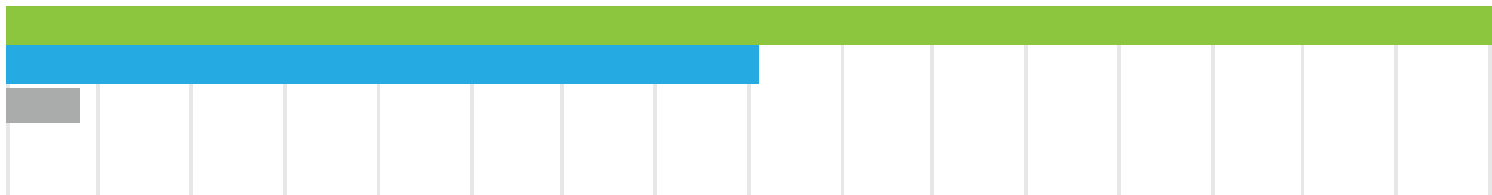


This graphic comparison chart demonstrates relative performance of this DOE Zero Energy Ready Home to existing homes (built between 1990 and 2010) and ENERGY STAR Certified Homes. Actual performance may vary.



303-231-4567  
NewTown@net.com  
123 Main Street, Denver, CO 34567

## HEALTHFUL ENVIRONMENT



- KEY**
- DOE Zero Energy Ready Home
  - ENERGY STAR Home
  - Existing Home

This label indicates relative performance of this DOE Zero Energy Ready Home to existing homes (built between 1990 and 2010) and ENERGY STAR qualified homes. Actual performance may vary.



U.S. DEPARTMENT OF  
**ENERGY**

# Clarity: Translating Value

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Front Cover



Inside Spread



Flap

Back Cover



## VIVID LIVING HEALTHFUL ENVIRONMENT



### Fresh Air

- Supply Fresh Air System
- Odor and Moisture Control Fans
- High-Capture Filtration Technology

### Quiet

- Quiet Window Technology
- Quiet Wall Technology

### Moisture Control

- Dry-by-Design Construction
- Moisture Control System – Whole House
- Moisture Controlled Comfort System
- Moisture Controlled Windows
- Moisture Controlled Lower Level

### Pest Control

- Bug Control Barrier
- Pest Screened Home

### Outdoor Contaminant Control

- Contaminant Sealed Construction
- Contaminant Sealed Comfort Delivery
- Dust and Pollen Barrier
- Radon Controlled Home

### Chemical Control

- Formaldehyde Controlled Home
- VOC Controlled Home

### Fume Control

- Carbon Monoxide Controlled Equipment
- Carbon Monoxide Controlled Fireplace
- Fume Controlled Garage

Vivid Living • 42 Sample Street, Suite 500, Anytown, MA 02460 • 617.467.3902 • [www.vividliving.com](http://www.vividliving.com)

# Clarity: Translating Value

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Front Cover



Inside Spread



Flap

Back Cover





**My power bill is \$5.  
What's yours?**

- Heather Robbins, Garbett Homeowner

**garbettHOMES.com**  
Now you're living.

**ZERO**  
ENERGY READY HOME  
U.S. DEPARTMENT OF ENERGY

“Our daughter couldn’t breathe  
without discomfort for years.  
Within two months of moving into  
our new Cobblestone home

**we threw away  
the inhaler.**

**That was  
priceless!”**

Charly and Mary Jones,  
Cobblestone Homeowner



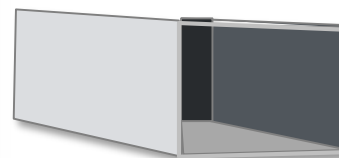
# Clarity: Translating Value



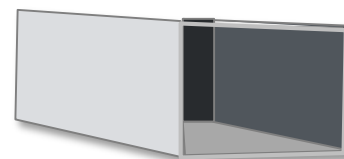




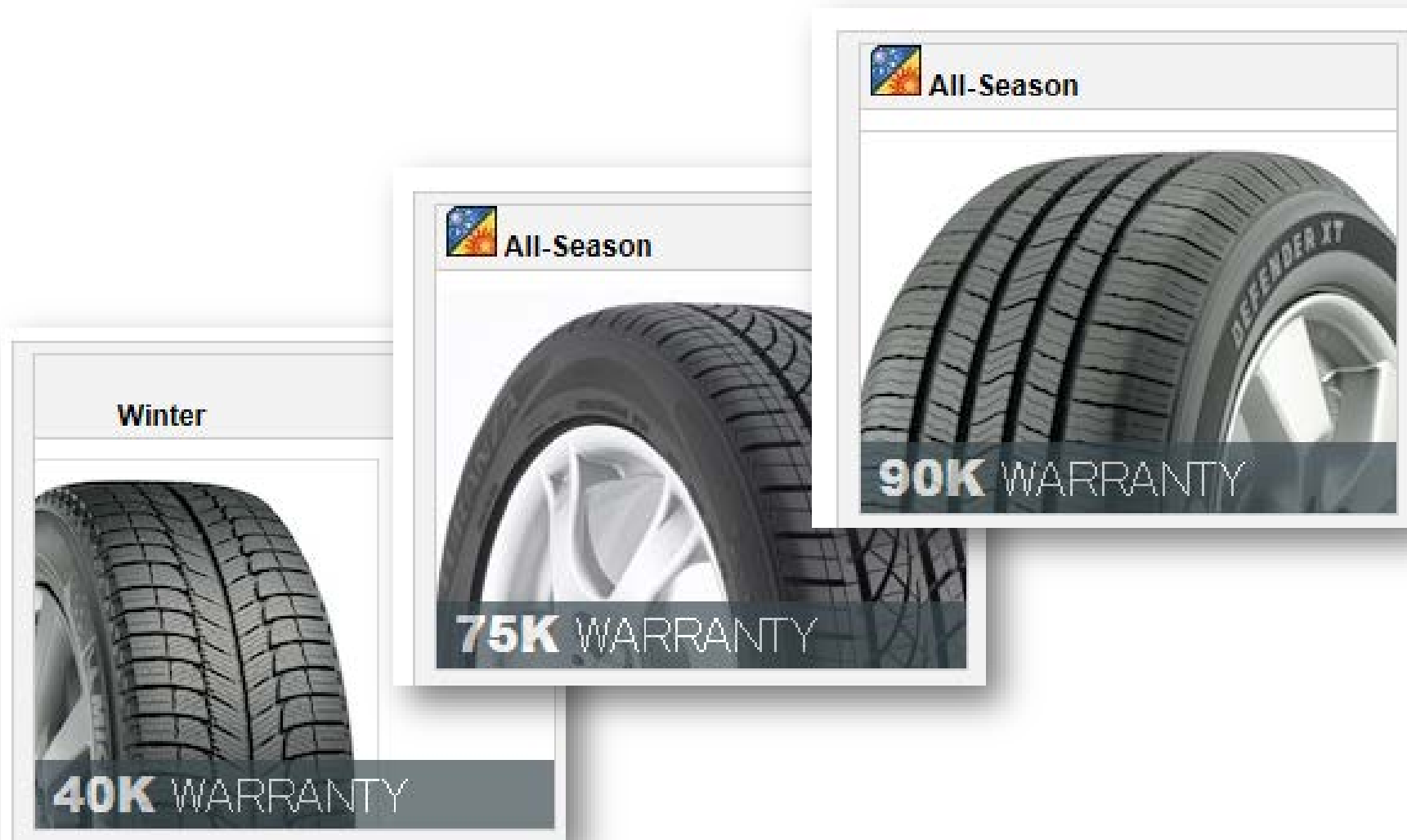
Smart vs.  
Dumb  
Cooling



## Smart vs. Dumb Heating




# Clarity: Translating Relative Value





# Clarity: Relative Value Confusion



National Fenestration  
Rating Council®  
**CERTIFIED**

**World's Best Window Co.**

Millennium 2000+  
Vinyl-Clad Wood Frame  
Double Glazing • Argon Fill • Low E  
Product Type: **Vertical Slider**

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
<b>0.35</b>	<b>0.32</b>

ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./I-P)
<b>0.51</b>	<b>0.2</b>
Condensation Resistance	
<b>51</b>	<b>—</b>

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)



National Fenestration  
Rating Council  
**CERTIFIED**

**World's Better than Best Window Co.**

Ultra-Millennium 3000+  
Vinyl Extruded, UltraCore Frame  
Triple-Glazed \* Krypton 90, Low-E  
Product Type: **Vertical Slider**

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
<b>0.18</b>	<b>0.22</b>

ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./I-P)
<b>0.42</b>	<b>0.1</b>
Condensation Resistance	
<b>70</b>	

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)

# Clarity: Relative Value Translated



National Fenestration  
Rating Council®  
**CERTIFIED**

## World's Best Window Co.

Millennium 2000+  
Vinyl-Clad Wood Frame  
Double Glazing • Argon Fill • Low E  
Product Type: **Vertical Slider**

Thermal Protection	<div><div></div></div>
Sun Protection	<div><div></div></div>
Natural Light	<div><div></div></div>
Draft Protection	<div><div></div></div>
Condensation Control	<div><div></div></div>

# 10-Year Window

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)



National Fenestration  
Rating Council  
**CERTIFIED**

## World's Better than Best Window Co.

Ultra-Millennium 3000+  
Vinyl Extruded, UltraCore Frame  
Triple-Glazed \* Krypton 90, Low-E  
Product Type: **Vertical Slider**

Thermal Protection	<div><div></div></div>
Sun Protection	<div><div></div></div>
Natural Light	<div><div></div></div>
Draft Protection	<div><div></div></div>
Condensation Control	<div><div></div></div>

# 50-Year Window

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)

## Energy Efficiency & Renewable Energy



# Clarity: Relative Value Translated





# Zero Energy Ready Home Training

## **Zero Builders in Action**

Builder 1

Builder 2



# Zero Energy Ready Home Training

## **Zero Specifications**



## Single-Family Detached



## Single-Family Attached



## Multi-Family Dwelling Units

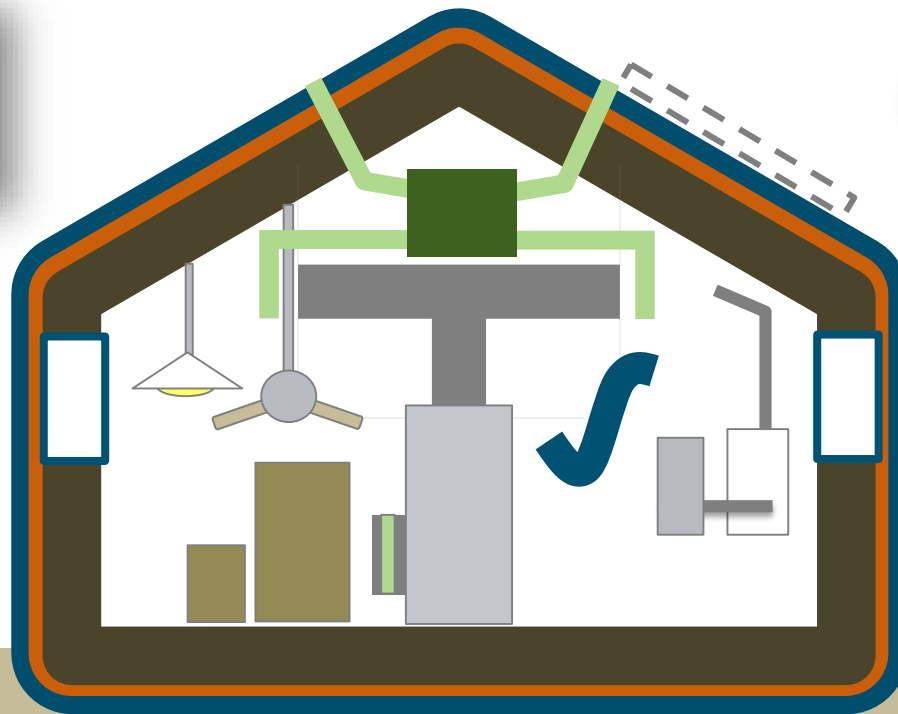
- $\leq 5$  Stories Above-Grade
- Individual HVAC
- Dwelling Units Occupy  $\geq 80\%$  Occupiable SF
- Individual or Central DHW (no solar required)



# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Optimized  
Enclosure  
System

Water  
Protection  
System

Optimized  
Comfort  
System

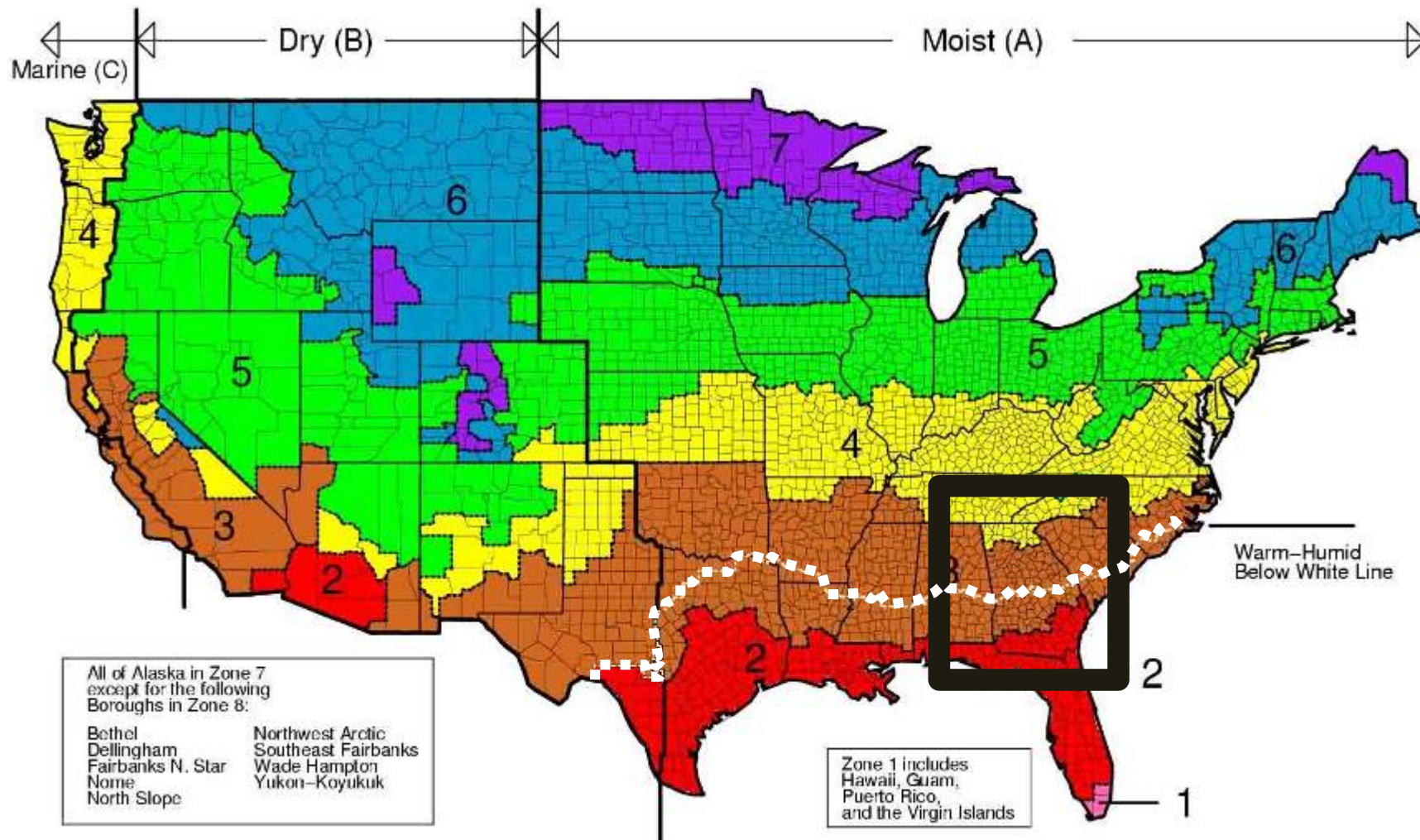
Indoor Air  
Quality  
System

Efficient  
Comps  
System

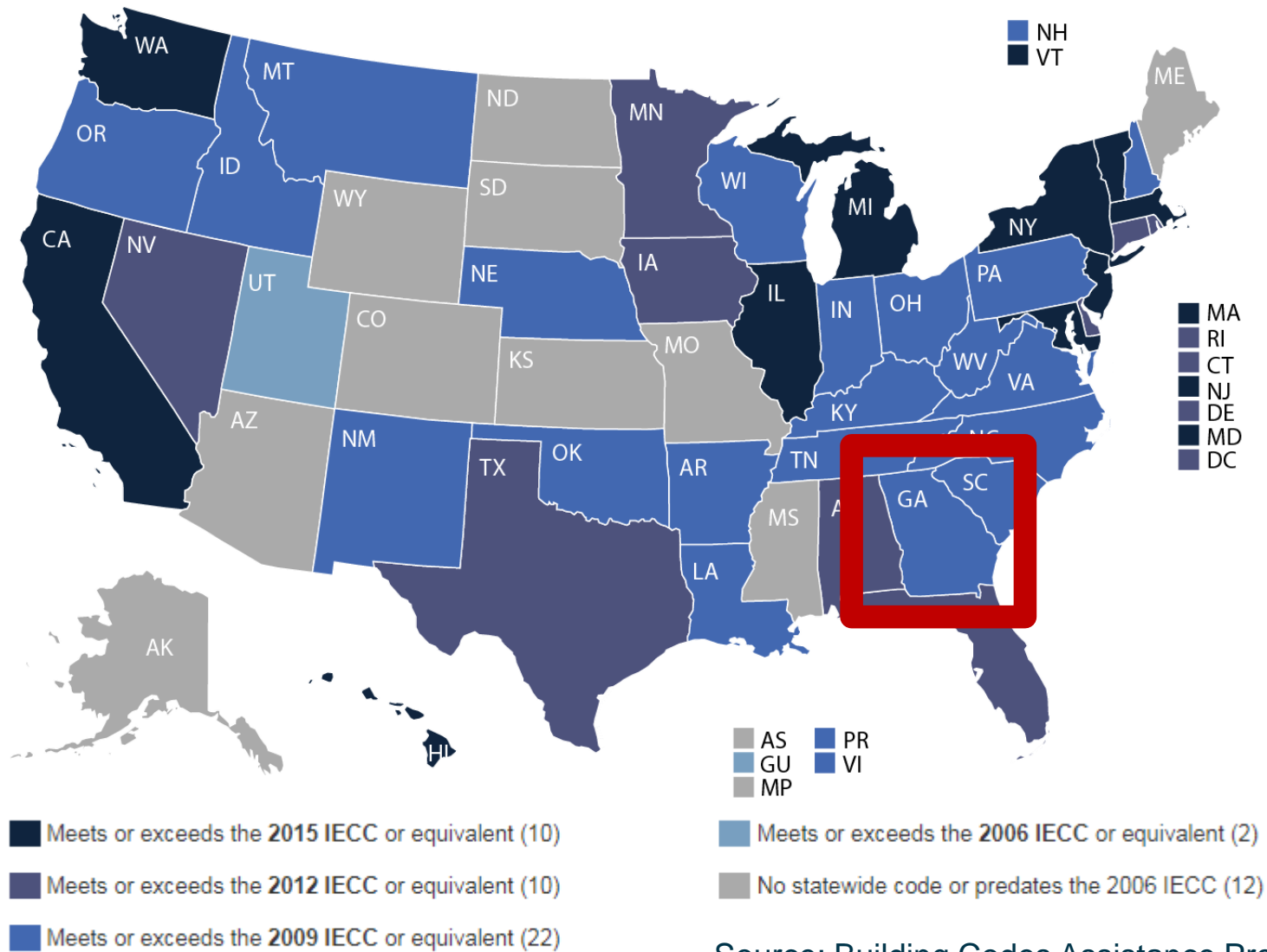
Solar  
Ready  
System

Six Complete Systems for Risk Management

# IECC Climate Zones



# IECC Code Map





# Strategy: Align w/ENERGY STAR

- Building-Science Underpinning
- Variable vs. Fixed HERS Index Score
- House Size Adjustment
- Coordinated Performance Path



1

## Mandatory Requirements

Targeted 'Must-Have' Innovations

Exhibit 1: DOE Challenge Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. ENERGY STAR for Homes Baseline	<input type="checkbox"/> Certified under ENERGY STAR Qualified Homes Version 3 <sup>5</sup>
2. Envelope <sup>6</sup>	<input type="checkbox"/> Fenestration shall meet or exceed latest ENERGY STAR requirements <sup>7, 8</sup> <input type="checkbox"/> Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 IECC levels <sup>9</sup>
3. Duct System	<input type="checkbox"/> Ducts located within the home's thermal and air barrier boundary <sup>10</sup>
4. Water Efficiency	<input type="checkbox"/> Hot water delivery systems shall meet efficient design requirements <sup>11</sup>
5. Lighting & Appliances <sup>12</sup>	<input type="checkbox"/> All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. <input type="checkbox"/> 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	<input type="checkbox"/> EPA Indoor airPLUS Verification Checklist and Construction Specifications <sup>13</sup>
7. Renewable Ready <sup>14</sup>	<input type="checkbox"/> EPA Renewable Energy Ready Home Solar Electric Checklist and Specifications <sup>15</sup> <input type="checkbox"/> EPA Renewable Energy Ready Home Solar Thermal Checklist and Specifications <sup>16</sup>

2

## Performance Score

Ensure Efficiency with Trade-Off Flexibility

Exhibit 2: DOE Challenge Home Target Home<sup>3, 17</sup>

HVAC Equipment <sup>18</sup>			
	Hot Climates (2012 IECC Zones 1,2) <sup>19</sup>	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9	10 <sup>20</sup>
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House Mechanical Ventilation System	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
Insulation and Infiltration			
<ul style="list-style-type: none"> <li>Insulation levels shall meet the 2012 IECC and achieve Grade 1 Installation, per RESNET standards.</li> <li>Infiltration<sup>21</sup> (ACH50): 3 in CZ's 1-2   2.5 in CZ's 3-4   2 in CZ's 5-7   1.5 in CZ 8</li> </ul>			
Windows <sup>22, 23, 24</sup>			
	Hot Climates (2012 IECC Zones 1,2,)	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
SHGC	0.25	0.27	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs. <sup>25</sup>			
Water Heater			
ENERGY STAR minimum; for heating oil water heaters use EF = 0.60			

Exhibit 3: Benchmark Home Size<sup>26</sup>

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area <sup>27</sup> Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,800	5,200

## Independent Verification (HERS)

3

## Size Adjustment Factor

Ensure Carbon Footprint



# Mandatory Requirements

**Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements for All Labeled Homes**

Area of Improvement	Mandatory Requirements
<b>1. ENERGY STAR for Homes Baseline</b>	<input type="checkbox"/> Certified under ENERGY STAR Qualified Homes Version 3 or 3.1 <sup>9, 10</sup>
<b>2. Envelope<sup>11</sup></b>	<input type="checkbox"/> Fenestration shall meet or exceed ENERGY STAR requirements <sup>12, 13</sup> <input type="checkbox"/> Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 or 2015 IECC levels <sup>14, 15</sup>
<b>3. Duct System</b>	<input type="checkbox"/> Duct distribution systems located within the home's thermal and air barrier boundary or optimized to achieve comparable performance <sup>16</sup>
<b>4. Water Efficiency</b>	<input type="checkbox"/> Hot water delivery systems shall meet efficient design requirements <sup>17</sup>
<b>5. Lighting &amp; Appliances<sup>18</sup></b>	<input type="checkbox"/> All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. <input type="checkbox"/> 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
<b>6. Indoor Air Quality</b>	<input type="checkbox"/> Certified under EPA Indoor airPLUS <sup>10</sup>
<b>7. Renewable Ready</b>	<input type="checkbox"/> Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist are Completed; (Solar Hot Water Ready provisions are encouraged but not required) <sup>19</sup>

## Encouraged:

- WaterSense Label (indoor and outdoor)
- Disaster Resistance (IBHS Fortified Home)
- Quality Management

# ZERH vs. ES Target Home Spec

Exhibit 2: DOE Zero Energy Ready Home Target Home <sup>7, 20</sup>

Higher Eff.  
HVAC  
Equip.

Both 2012  
IECC Insul.  
v3.1

Half ACH50

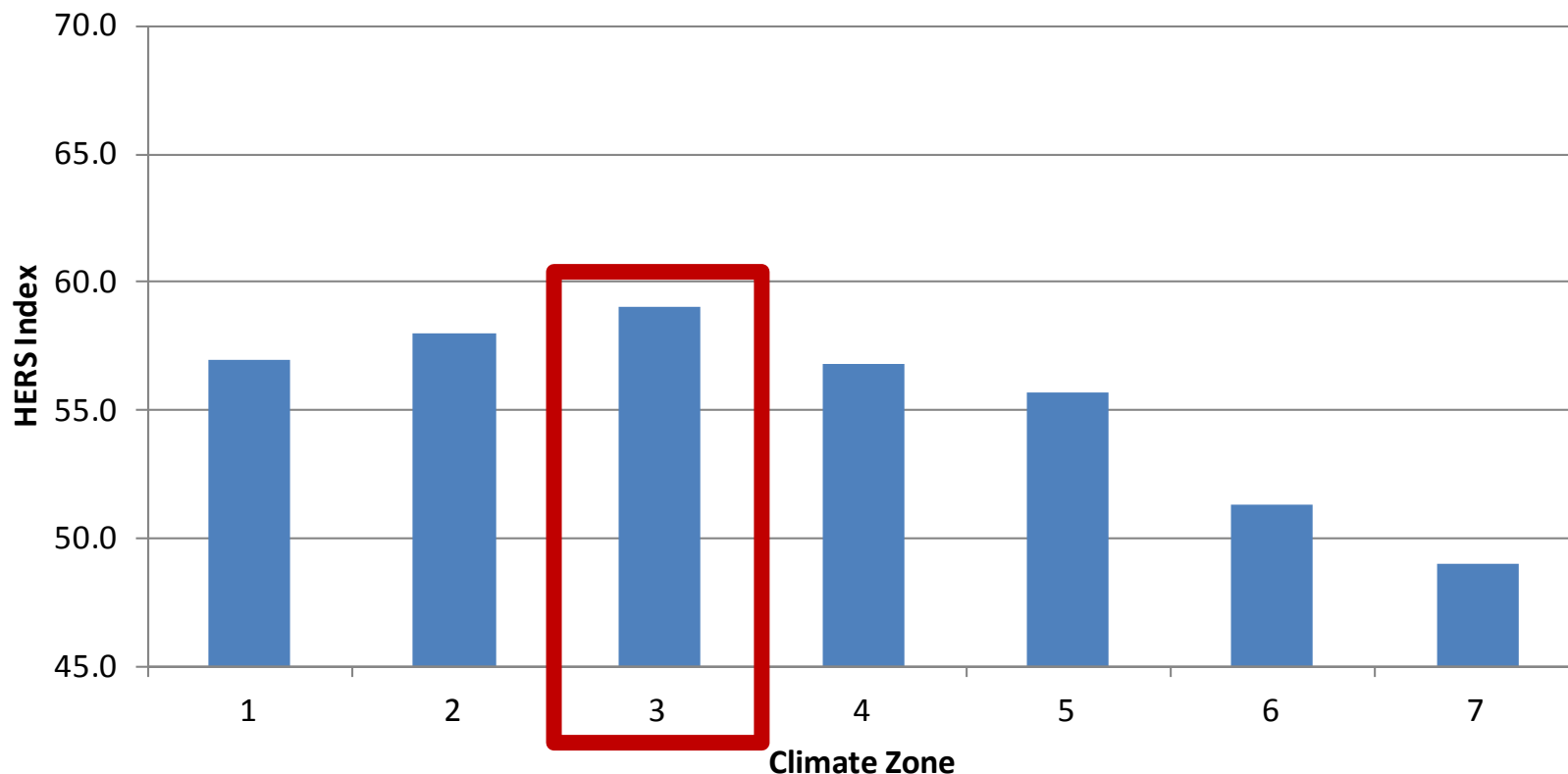
More Eff.  
Windows

ENERGY  
STAR vs.  
Min. WH

HVAC Equipment <sup>21</sup>			
	Hot Climates (2012 IECC Zones 1,2) <sup>22</sup>	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9	10 <sup>23</sup>
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House Mechanical Ventilation System	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
Insulation and Infiltration			
Insulation levels shall meet the 2012 IECC and achieve Grade 1 installation, per RESNET standards.			
<ul style="list-style-type: none"> <li>Infiltration<sup>24</sup> (ACH50): 3 in CZ's 1-2   2.5 in CZ's 3-4   2 in CZ's 5-7   1.5 in CZ 8</li> </ul>			
Windows <sup>25, 26, 27</sup>			
	Hot Climates (2012 IECC Zones 1,2,)	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)
SHGC	0.25	0.25	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs. <sup>28</sup>			
Water Heater			
ENERGY STAR levels for the system Energy Factor, as follows:			
<ul style="list-style-type: none"> <li>Gas/propane systems of ≤ 55 gallons, EF = 0.67</li> <li>Gas/propane systems of &gt; 55 gallons, EF = 0.77</li> <li>Electric systems, EF = 2.0</li> </ul>			
For heating oil water heaters use EF = 0.60			
Thermostat <sup>29</sup>			
<ul style="list-style-type: none"> <li>Programmable thermostat (except for zones with radiant heat)</li> </ul>			
Lighting & Appliances			
<ul style="list-style-type: none"> <li>For purposes of calculating the DOE Zero Energy Ready Home Target Home HERS Index, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator, ENERGY STAR ceiling fans, and ENERGY STAR lamps (bulbs) in 80% of sockets or 80% of lighting fixtures are ENERGY STAR Qualified.</li> </ul>			

# ZERH Average HERS Scores

**Typical DOE ZERH-Compliant HERS Index by Climate Zone**  
(Overall Average = 55.5)



Based on 1800, 2400, and 3600 ft<sup>2</sup> prototypes on climate-appropriate foundations.

Homes larger than the benchmark home size must use the size adjustment factor to determine the target HERS index

Exhibit 3: Benchmark Home Size<sup>26</sup>

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area <small>Benchmark Home</small>	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

**Note:** Renewable energy systems may not be used to qualify for the ZERH HERS Index Target Score, but may be used for the *incremental* HERS Index points needed for the Size Adjustment Factor.

Size Mod. Factor =  $\left[ \text{CFA}_{\text{Benchmark Home}} / \text{CFA}_{\text{Home to Be Built}} \right]^{0.25}$   
[Not to Exceed 1.0]

# Performance Path Example

## CZ2 Prototype - 4 BR, 3500 SF

Specification	Target Home Spec	Design Home
Mandatory Items: ducts in conditioned space; 2012 IECC insulation; etc.		Meets all mandatory items; uses total UA to meet insulation reqmnt.
Windows	U=0.40; SHGC=0.25	U=0.32; SHGC=0.24
Infiltration	3 ACH50	2.5 ACH50
Duct Leakage	Total $\leq 8$ CFM25 per 100 SF of CFA; Leakage to outdoors $\leq 4$ CFM25 per 100 SF of CFA	Total leakage $\leq 280$ CFM25 Leakage to outdoors $\leq 140$ CFM25
Furnace AFUE	80	92
A/C SEER	18	16
Whole-House Mech. Vent.	75 cfm; 1.4 cfm/W;	75 cfm; 5.0 cfm/W
Water Heater	ENERGY STAR	Gas storage 0.67 EF
Target Home HERS Index	55; (52 with SAF)	
HERS Index – Design Home		52 – <b>COMPLIES!</b>

- Same: ENERGY STAR Homes framework
- New:
  - Indoor airPLUS Checklist;
  - Renewable Energy Ready Home Checklists (if req'd.)
  - Hot Water Distribution test
- Submissions:
  - Current:** Send “DOE ZERH Verification Summary” electronically to [zero@newportpartnersllc.com](mailto:zero@newportpartnersllc.com)
  - Future:** Automatically submitted as part of rating to RESNET National Homes Registry



- Technical Webinars
- Webinar Meetings
- Building America Solution Center (BASC)
- Building America Research Studies
- Leading Builder Round-Table Meetings

**For Info:** [www.buildings.energy.gov/zero/](http://www.buildings.energy.gov/zero/)



Zero Energy Ready Home Training

Zero Specifications

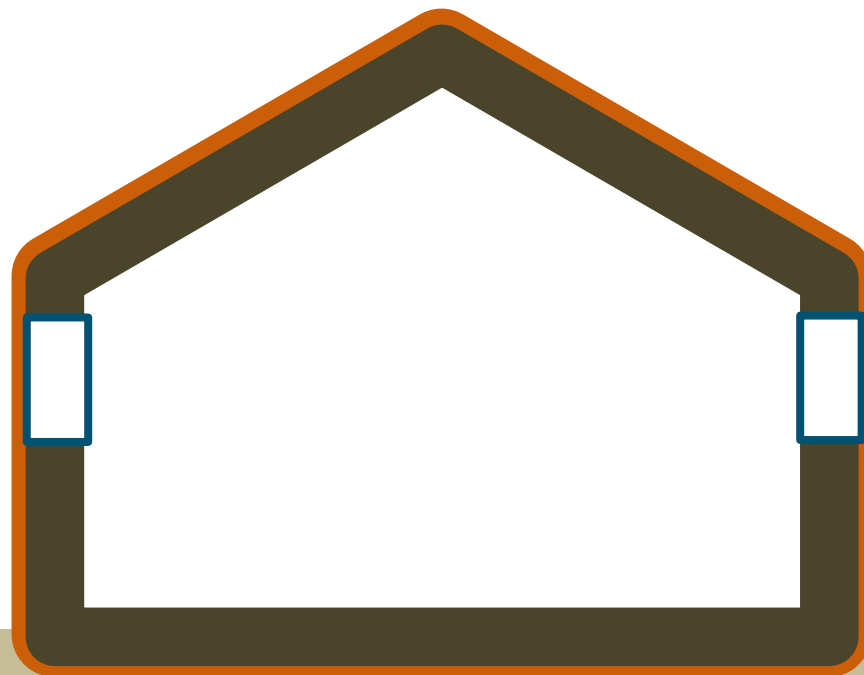
**Optimized Enclosure**

# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

Optimized  
Enclosure  
System



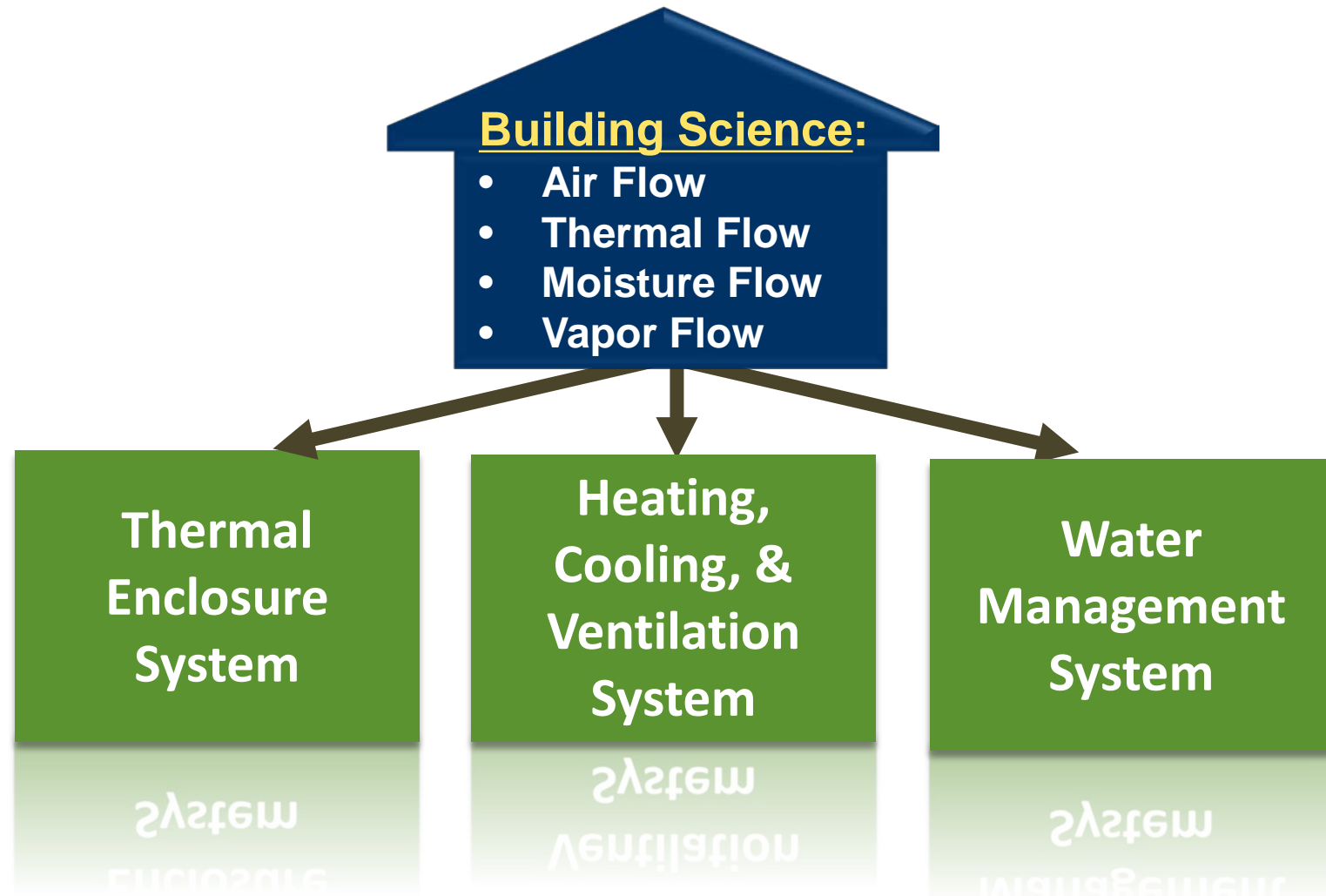
+

2012 / 2015 IECC  
Envelope Insulation  
Tighter Construction  
ENERGY STAR Windows

=



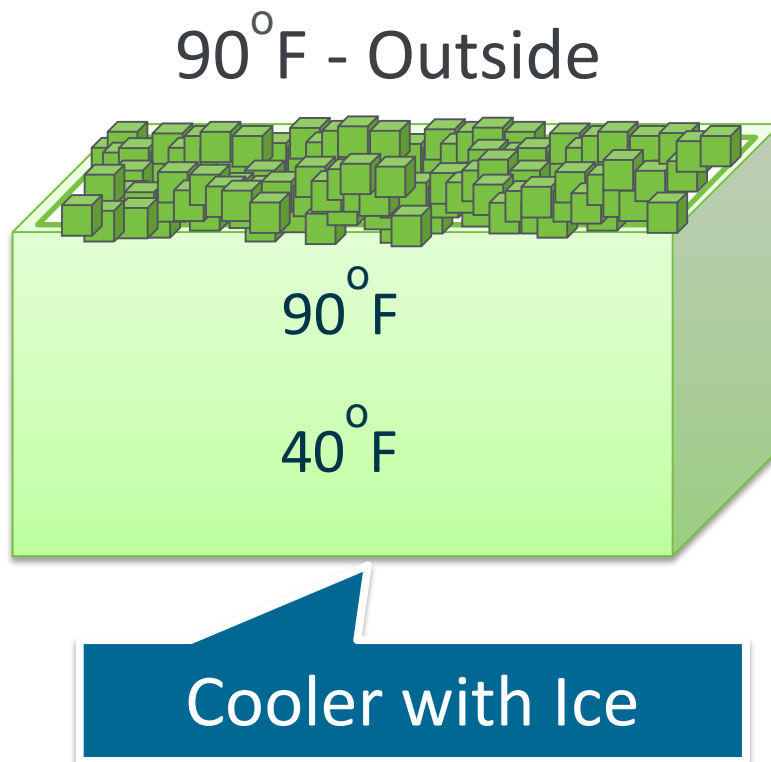
# Optimized Enclosure is Part of Complete Building Science System



## Rate of Thermal Flow:

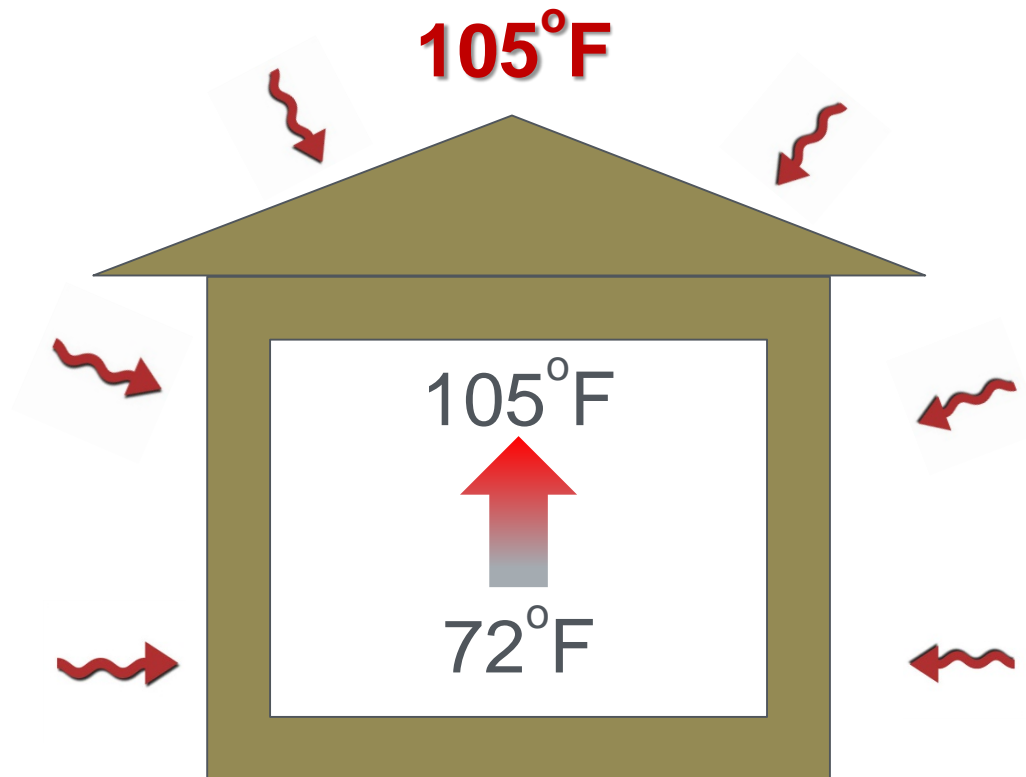
A well-insulated and air-sealed home,  
with good windows and doors,  
reduces the amount of energy needed  
to keep the home comfortable.

## Energy moves from more to less...

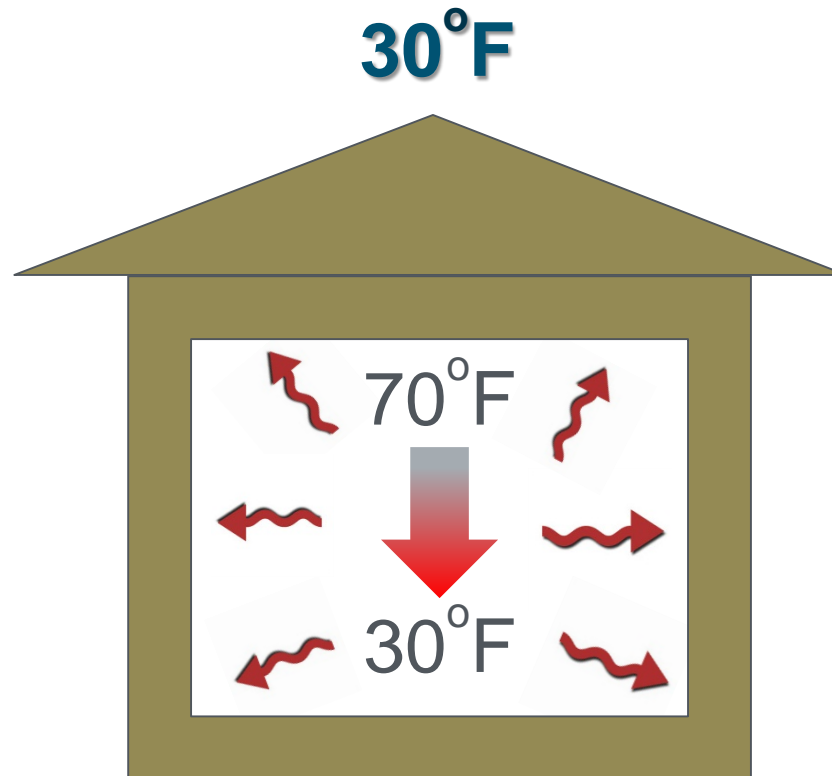




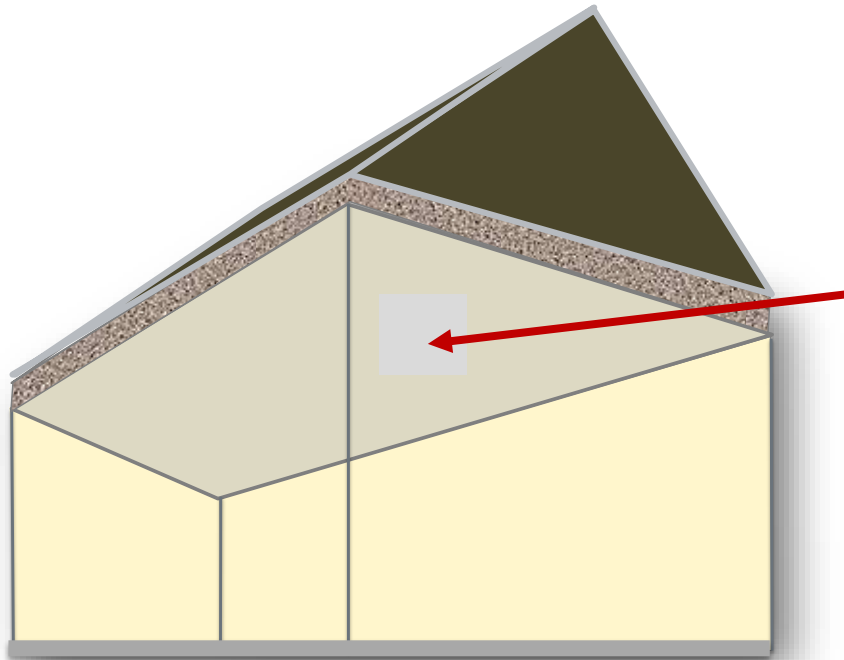
## Energy moves from more to less...



## Energy moves from more to less...



# Thermal Holes Are a Big Deal



1, 000 sq. ft. **R-38 Attic**

$U = .026$

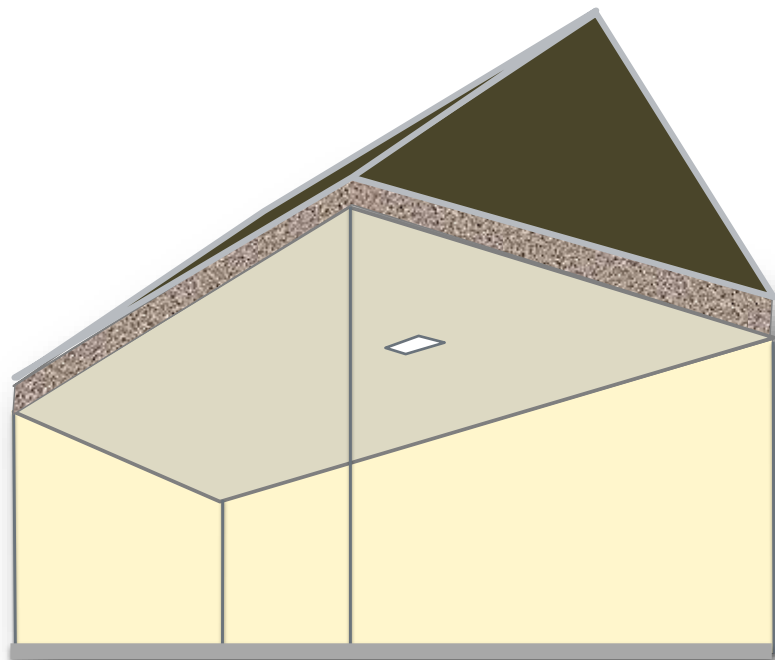
Drop-Down Stair = R-1

R-1,  $U = 1.0$

10 sq. ft. = 1% of area

What Percent Loss in  
Attic R-Value?

# Thermal Holes Are a Big Deal



Avg. U-value

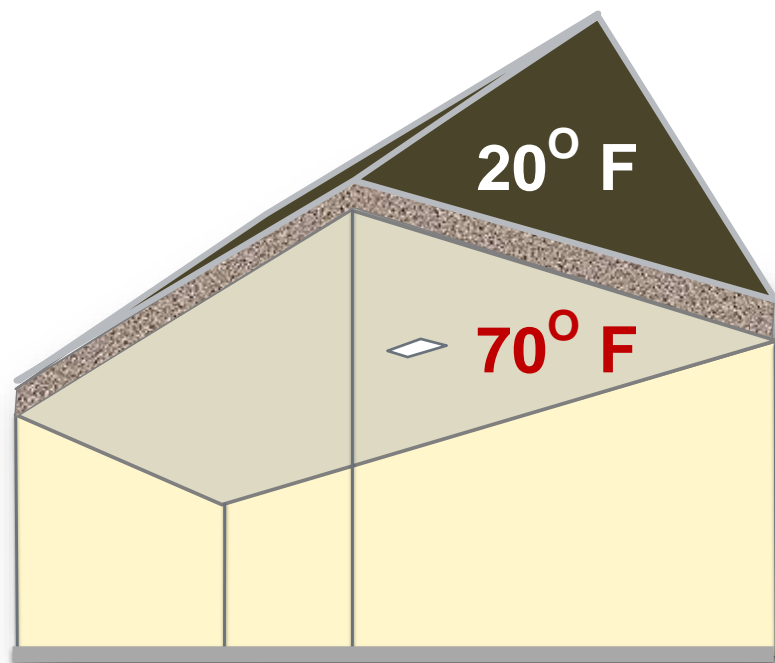
$$= \frac{U1 \times A1 + U2 \times A2 + \dots}{\text{Total Area (A)}}$$

$$= \frac{(.026 \times 990) + (1 \times 10)}{1,000}$$

$$= \frac{35.74}{1,000} = .036 = \mathbf{R-28}$$

**1% Hole Results in  
27% Lower R-Value  
(R-28 vs. R-38)**

# Thermal Holes Are a Big Deal



Assume 50° F temp  
difference at attic ceiling

$$\text{Heat Flow} = U \times A \times \Delta T$$

**Heat Flow without Hole**

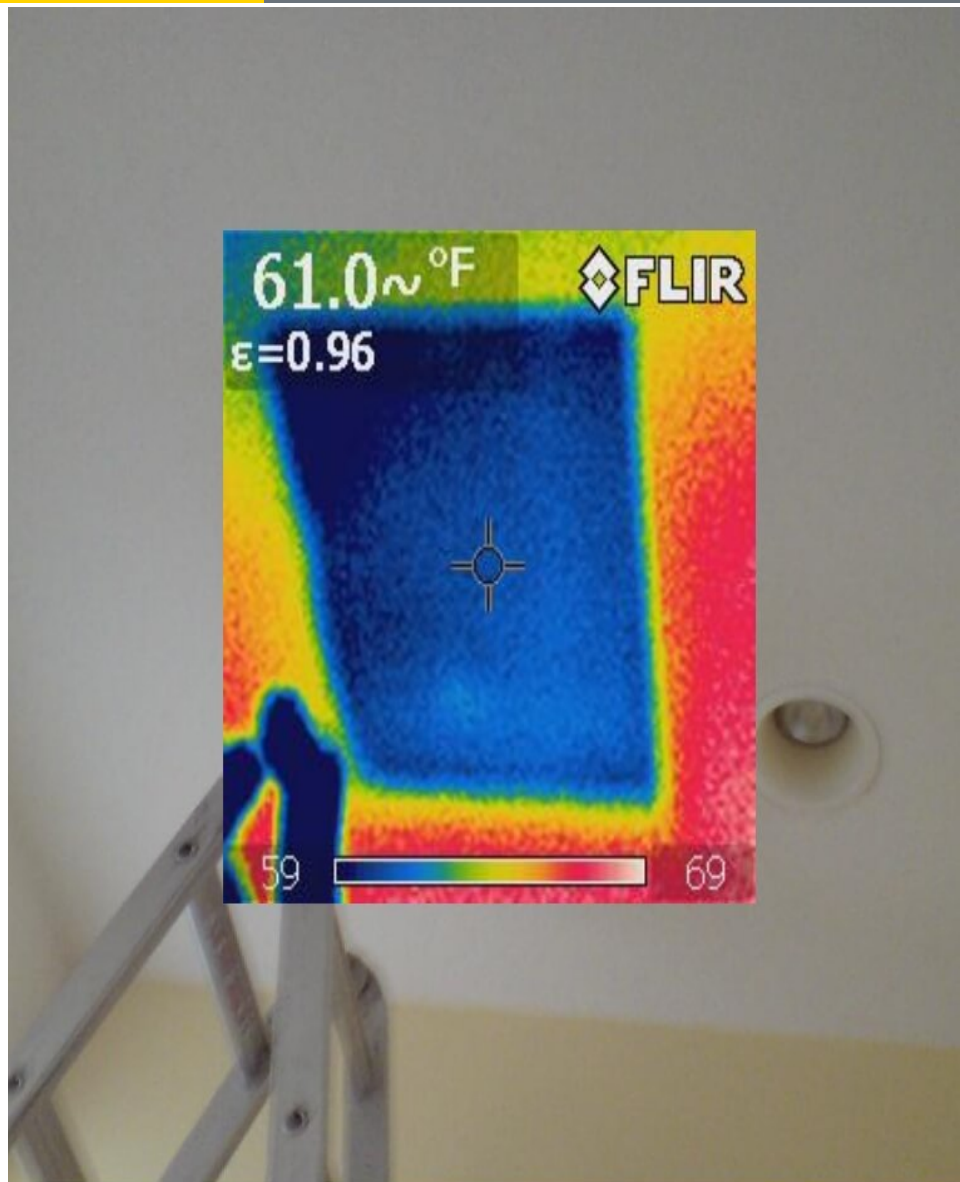
$$\begin{aligned} &= .026 \times 1,000 \times 50 \\ &= \mathbf{1316 \text{ Btu/hr}} \end{aligned}$$

**Heat Flow with Hole**

$$\begin{aligned} &= .036 \times 1,000 \times 50 \\ &= \mathbf{1786 \text{ Btu/hr}} \end{aligned}$$

**33%+ >Heat Flow  
with 1% Hole**

# Thermal Holes Are a Big Deal

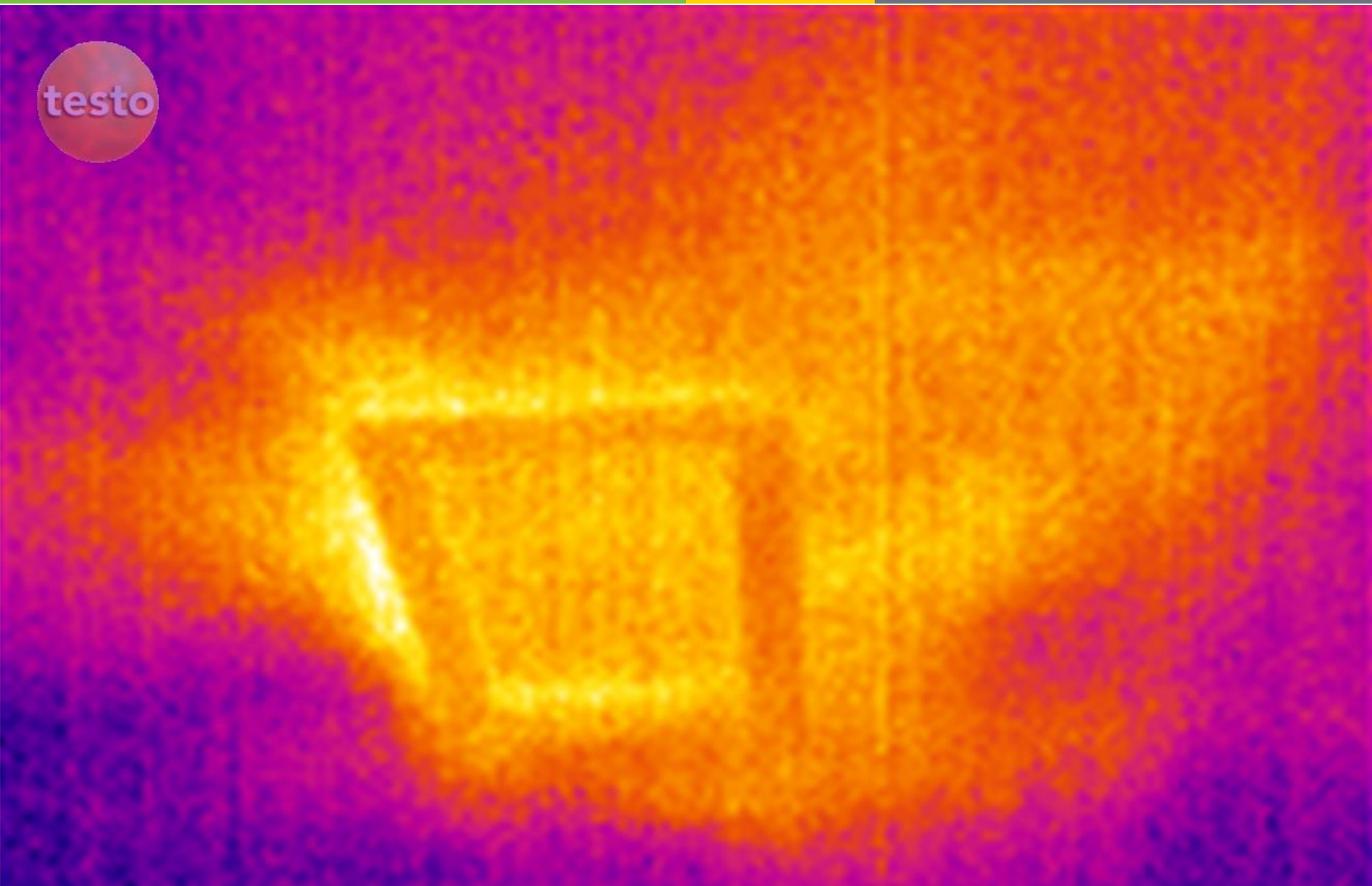




# Thermal Holes Are a Big Deal

U.S. DEPARTMENT OF  
**ENERGY**

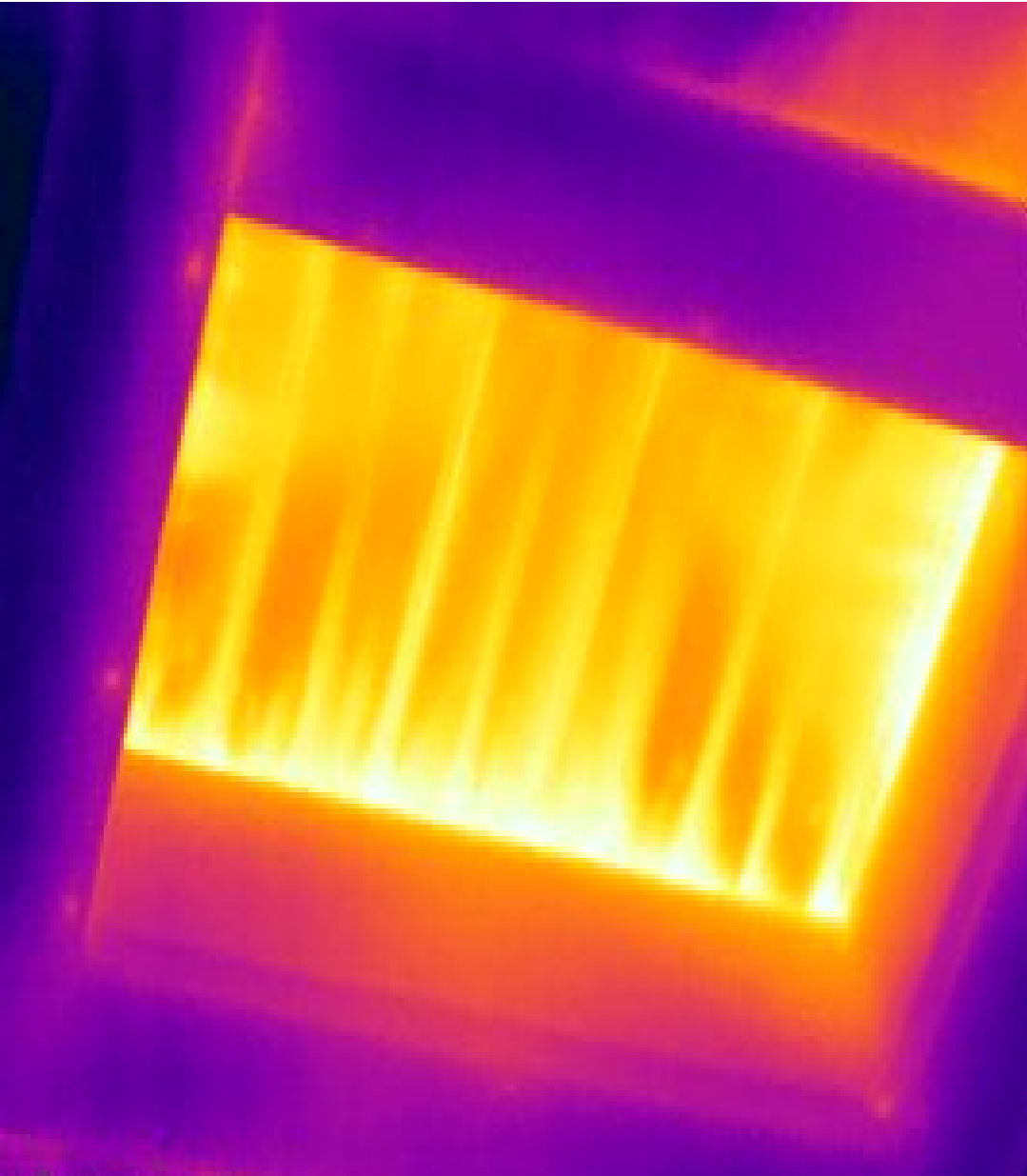
Energy Efficiency &  
Renewable Energy



# Thermal Holes Are a Big Deal

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



- **Air-Tight Construction**
- **Complete Air Barriers**
  - Thermal Bypass
  - Wind Intrusion
- **Insulation System**
  - Next Code Quantity
  - Proper Installation
  - Minimum Thermal Bridging
- **Advanced Windows**

**Air and Thermal  
Flow Control**



Zero Energy Ready Home Training

Zero Specifications  
Optimized Enclosure

**Air-Tight Construction**

- 16 to 50% of HVAC Loads
- Moisture Problems
- Comfort Problems
- Indoor Air Quality

# Target Home Air-Tightness

	ACH50 Requirements/Targets			
Climate Zones	Zero Energy Ready Home	ENERGY STAR V3	2012 IECC	Passive House
1-2	3.0	6.0	5.0	0.6
3-4	2.5	5.0	3.0	0.6
5-7	2.0	4.0	3.0	0.6
8	1.5	3.0	3.0	0.6



## Cracks:

- Sill Plates
- Windows & Doors
- Drywall at Top Plate
- Access Panels
- Sheathing Joints
- Foundation/Framing

## Penetrations:

- Plumbing
- Wiring
- Recessed Lights
- Vents
- HVAC Duct Boots

## Shafts:

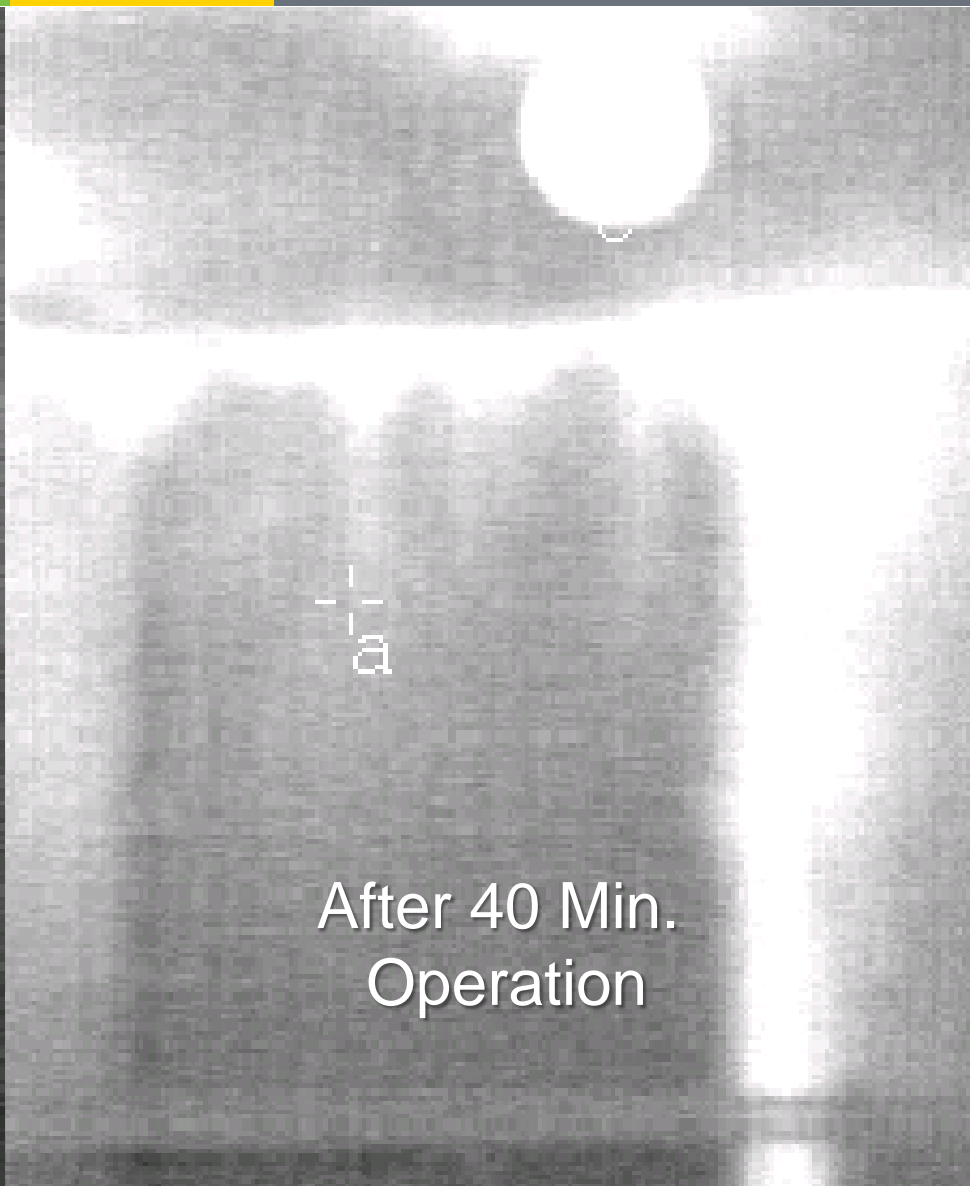
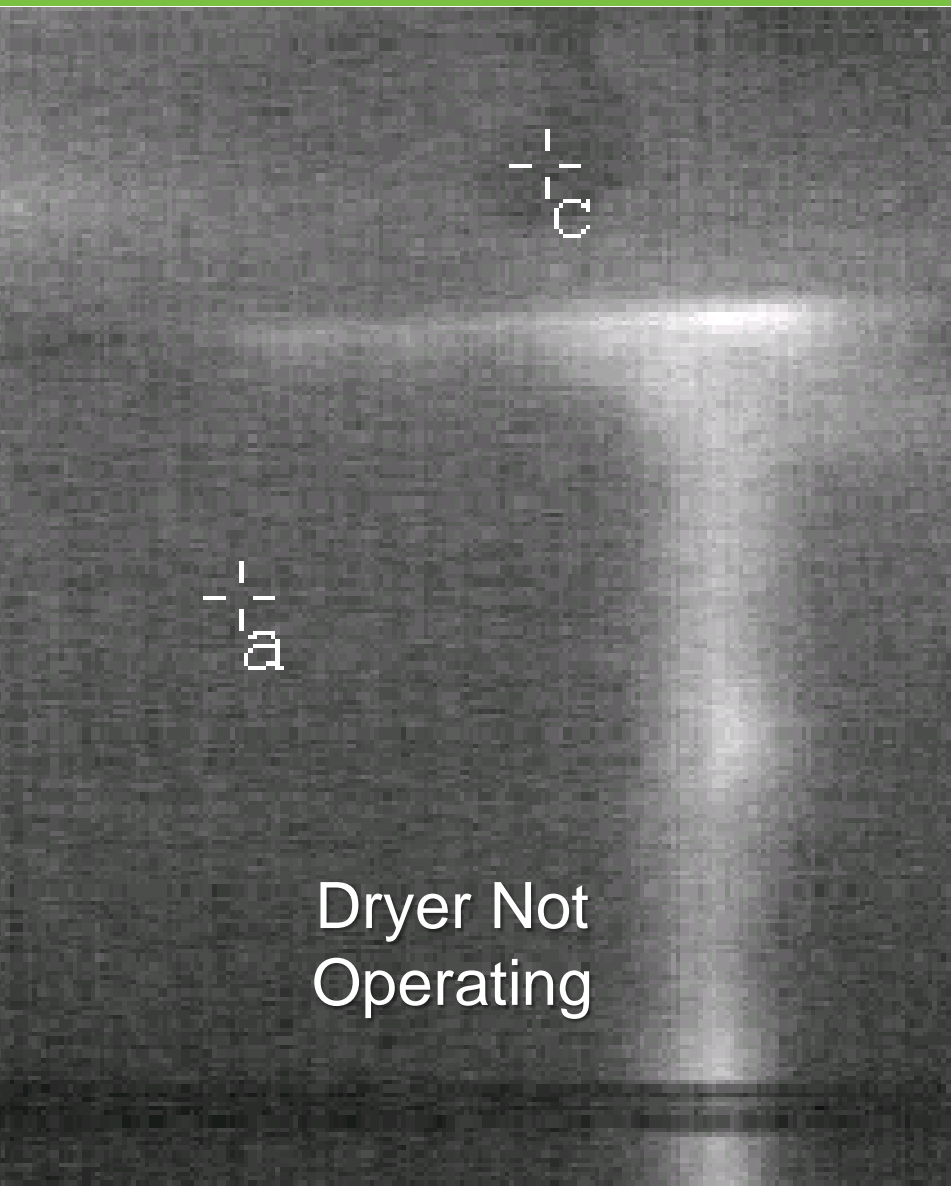
- Flues
- Ducts
- Plumbing

## Odd Geometry:

- Cantilevers
- Knee-walls



# What We're Trying to Avoid



# Drywall Sealed to Top Plate

## Default: Spray Foam



## Alternative: Sill sealer



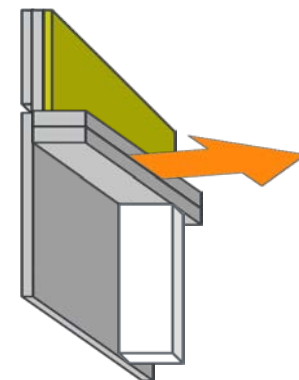
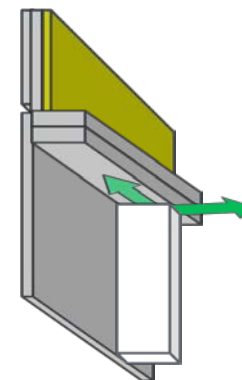
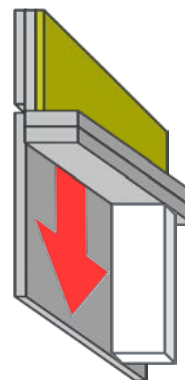
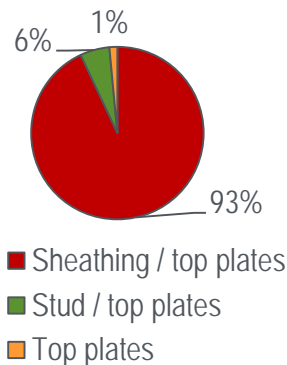
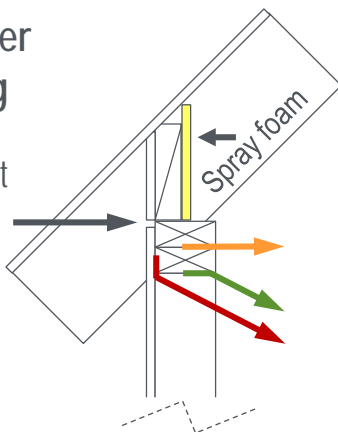
## Alternative: Constr. Adhesive



# Air Leakage Distribution

Exterior air barrier  
Cathedral ceiling

Sheathing / roof joint  
1.1 cfm/ft @ 50 Pa



2-Story house (Floor area = 2,000 ft<sup>2</sup>)  
Sheathing / roof joint unsealed  $\cong 0.5 \text{ ACH}_{50}$

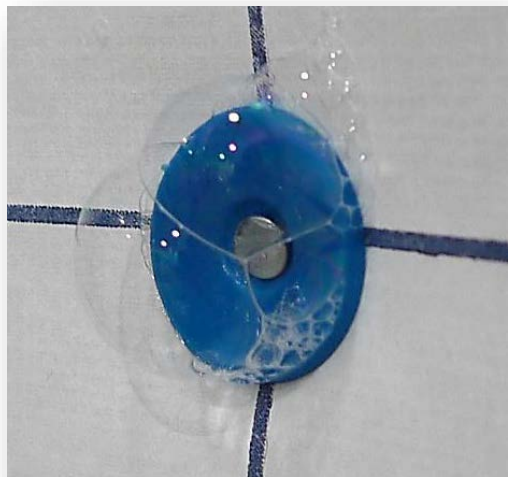
Zones	DOE Zero Energy Ready Home		IECC 2012	
	Requirement	Contribution to requirement (%)	Requirement	Contribution to requirement (%)
1 – 2	3	17	5	10
3 – 4	2.5	20	3	17
5 – 7	2	25	3	17
8	1.5	33	3	17

# Rectangular Electrical Box



- **1/8" to 1/4" perimeter gap**
- **~ 12 cfm @ 50 Pa**
- **Perimeter gap sealed**
  - Somewhat effectively with one-component polyurethane foam
  - Effectively with caulk
- **Wire holes  $\geq$  50% of leakage**





Air leaked at nailed fasteners



Repeat test with screwed fasteners



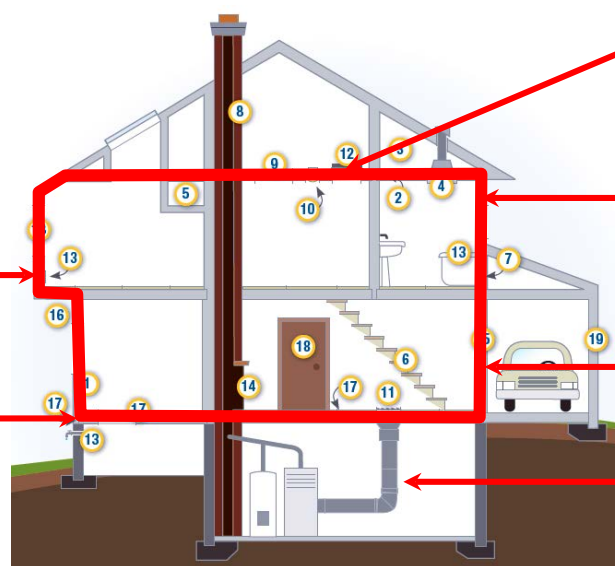
# Air Leakage Contribution Estimates

## Exterior Air Barrier:

2-Story House (2,000 sq. ft.)

(4) Elect. Outlets =  $0.17 \text{ ACH}_{50}$

Exterior Sheathing/Foundation  
=  $0.51 \text{ ACH}_{50}$



(5) Lights =  $0.29 \text{ ACH}_{50}$

Ext. Sheathing/Roof  
=  $0.51 \text{ ACH}_{50}$

**Air barrier**

Duct  $\cong 0.22 \text{ ACH}_{50}$

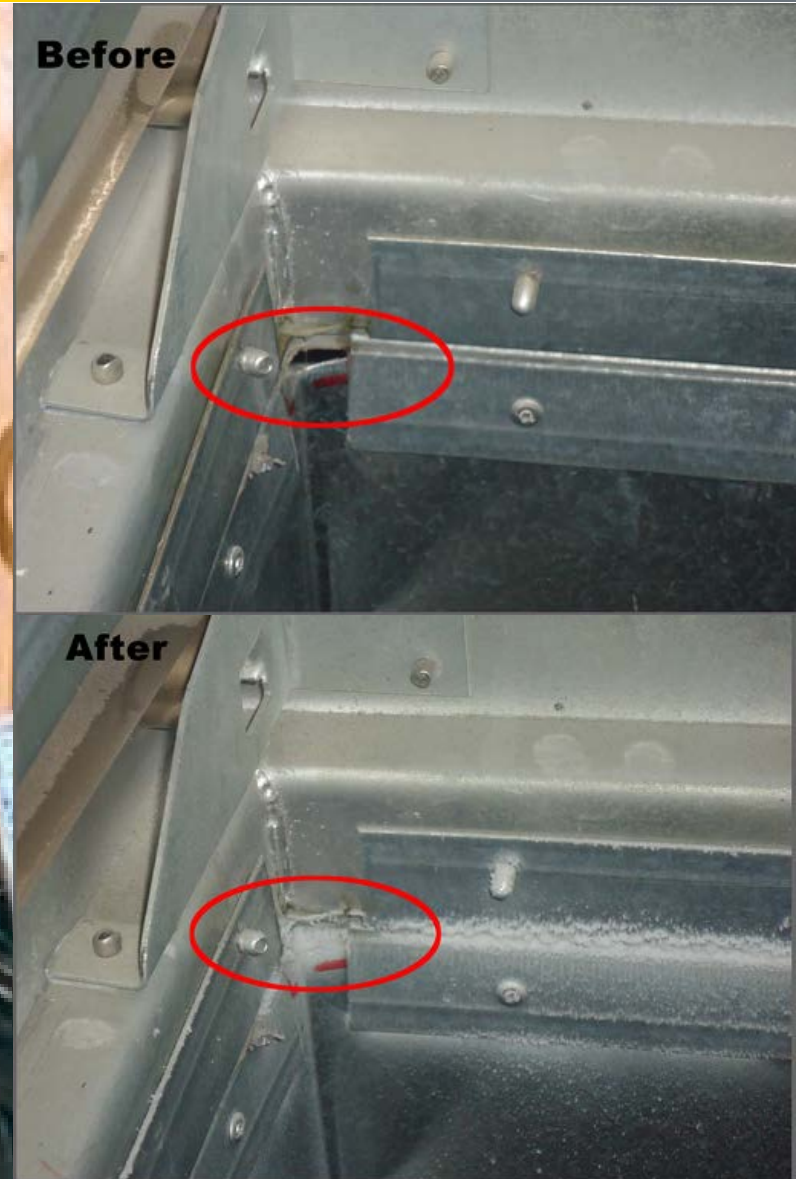
- |  |        |
|--|--------|
| 1. Sheathing/Foundation Joint Unsealed | = 0.51 |
| 2. Sheathing/Roof Joint Unsealed       | = 0.51 |
| 3. (4) Electrical Outlets              | = 0.17 |
| 4. (5) Ceiling Lights                  | = 0.29 |
| 5. <u>Return Duct</u>                  | = 0.22 |

**1.7  $\text{ACH}_{50}$**

# Sealing HVAC Ducts with AeroSeal

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Air Sealing Homes with Aerosol



Photos from [wcec.ucdavis.edu](http://wcec.ucdavis.edu)



Zero Energy Ready Home Training

Zero Specifications  
Optimized Enclosure

# High-Perf. Insulation System

- Complete Air Barriers
- Quality (Installation)
- Quantity (High-R)
  - Walls
  - Roof
  - Foundation

Changes Between the 2012 IECC and 2015 IECC				
	Change		No Change	
Prescriptive R-Value	Changes Between the 2012 IECC and 2015 IECC			
		Change	No Change	
	Prescriptive R-Value		X	
	U-Value Alternative	✓		
Total UA Alternative	✓			
U-Value Alternative	Changes Between the 2012 IECC and 2015 IECC			
		Change	No Change	
	Prescriptive R-Value		X	
	U-Value Alternative	✓		
Total UA Alternative	✓			
Total UA Alternative	Changes Between the 2012 IECC and 2015 IECC			
		Change	No Change	
	Prescriptive R-Value		X	
	U-Value Alternative	✓		
Total UA Alternative	✓			

**ONLY Change in U-Value is for Above-Grade Framed Walls**

**No Changes to Prescriptive R-Value Requirements**



# Above-Grade Frame Wall U-Factors

Climate Zone	2012 U-Factor Equivalent Above-Grade Frame Wall (Table 402.1.3)	2015 U-Factor Equivalent Above-Grade Frame Wall (Table 402.1.4)	Change (% and Direction)	
1	0.082	0.084	2% Decrease in Stringency	↓
2	0.082	0.084	2% Decrease in Stringency	↓
3	0.057	0.060	5% Decrease in Stringency	↓
4 except Marine	0.057	0.060	5% Decrease in Stringency	↓
5 and Marine 4	0.057	0.060	5% Decrease in Stringency	↓
6	0.048	0.045	6% Increase in Stringency	↑
7 and 8	0.048	0.045	6% Increase in Stringency	↑

- **No additional burden for most designs**
- In Climate Zones 1 – 5, meeting 2015 IECC via a whole-building UA tradeoff will be *very slightly less* stringent
  - Required Frame Wall U-Factor is 2 to 5% less stringent
  - Frame Walls might comprise ~ 20% – 40% of total shell area...

- Compliance with next generation code
- Three Options:
  - ✓ Prescriptive
  - ✓ Alternative equivalent U-factor
  - ✓ Total UA calculation  
[allows window to be included]
- Allowances for ceilings without attic spaces  
[up to 500 square feet or 20% of roof area,  
whichever is smaller]

	CZ 2	CZ 3
Walls	R-13 (rec. R13+5)	R-20 or R-13+5 (rec. R-13+5)
Ceiling	R-38	
Floor	R-13	R-19
Basement	R-0	R-5/13
Crawl Space	R-0	R-5-13
Slab	R-0 (rec. R-5 slab edge)	



Gap

Void

Compression

Misalignment

# Insulation Quality: Thermal Bridging

U.S. DEPARTMENT OF  
**ENERGY**

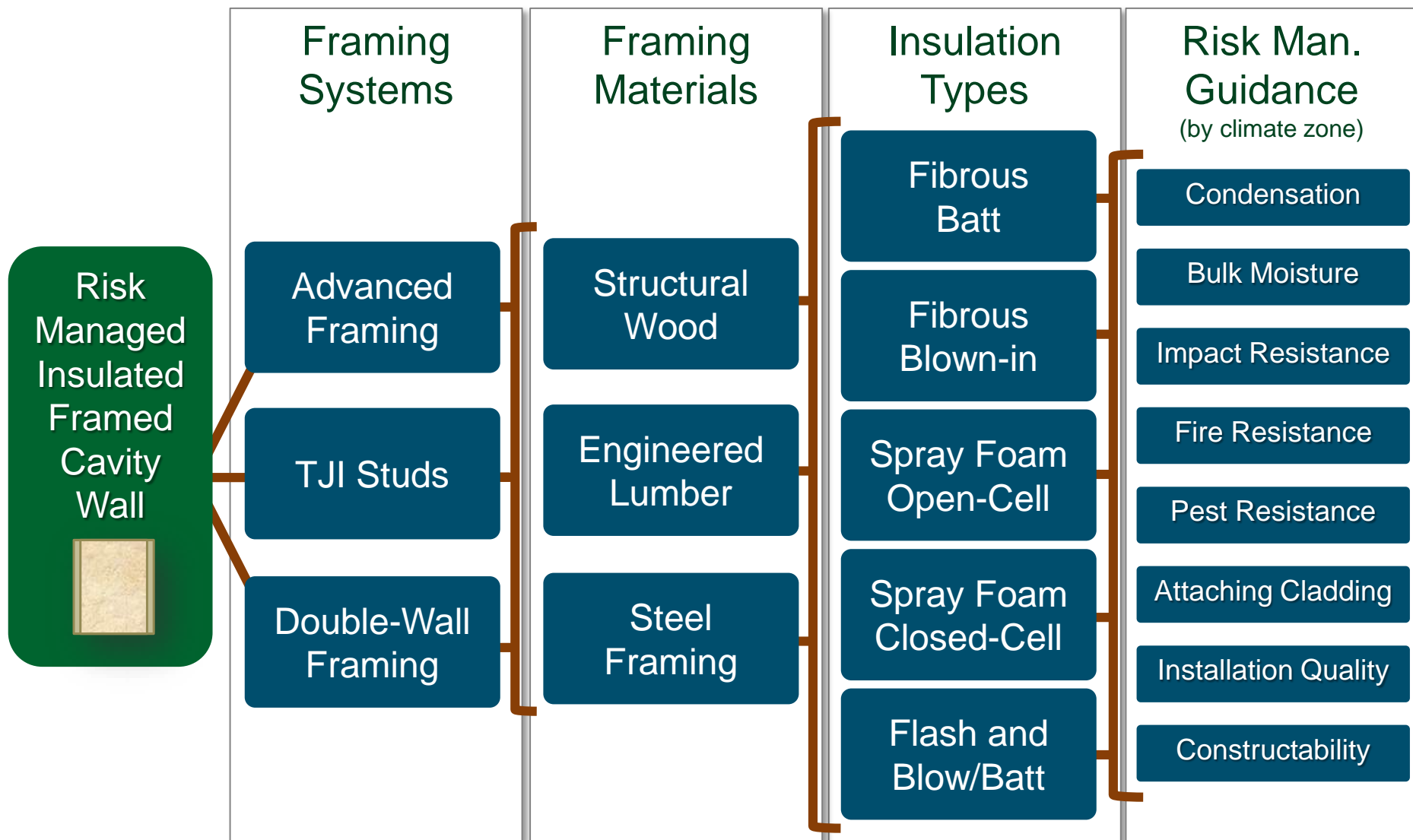
Energy Efficiency &  
Renewable Energy





# High-Perf. Insulation Guidance Tool

High-R Wall Options (Climate Zones 6-8)	Risk Management Issues								
	Thermal Bridging	Condensation Inside Wall	Bulk Moisture	Impact Resistance	Fire Resistance	Pest Resistance	Structural Support for Cladding	Installation Quality	Construction Practice
Insulated Framed Cavity Wall (Single or Double) 	Yellow	Red	Red	Red	Red	Red	Green	Red	Green
Insulated Framed Cavity Wall with ≤ 50% Insulation Outboard 	Green	Yellow	Red	Red	Red	Red	Yellow	Red	Yellow
Framed Assembly with ≥ 50% Insulation Outboard 	Green	Green	Red	Red	Red	Red	Red	Red	Red
Engineered Panel with Outboard Insulation 	Green	Yellow	Red	Yellow	Red	Red	Red	Green	Red
Structural Insulated Panel (SIP) System 	Green	Yellow	Red	Yellow	Red	Red	Green	Green	Red
Exterior Insulated Concrete/Masonry Wall System 	Green	Green	Green	Green	Green	Yellow	Green	Green	Red
Interior Insulated Concrete/Masonry Wall System 	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Red
Insulated Concrete Core System 	Green	Green	Green	Green	Green	Yellow	Green	Green	Yellow





Zero Energy Ready Home Training

Zero Specifications

Optimized Enclosure System

Insulation System

**Complete Air Barriers**

## Walls

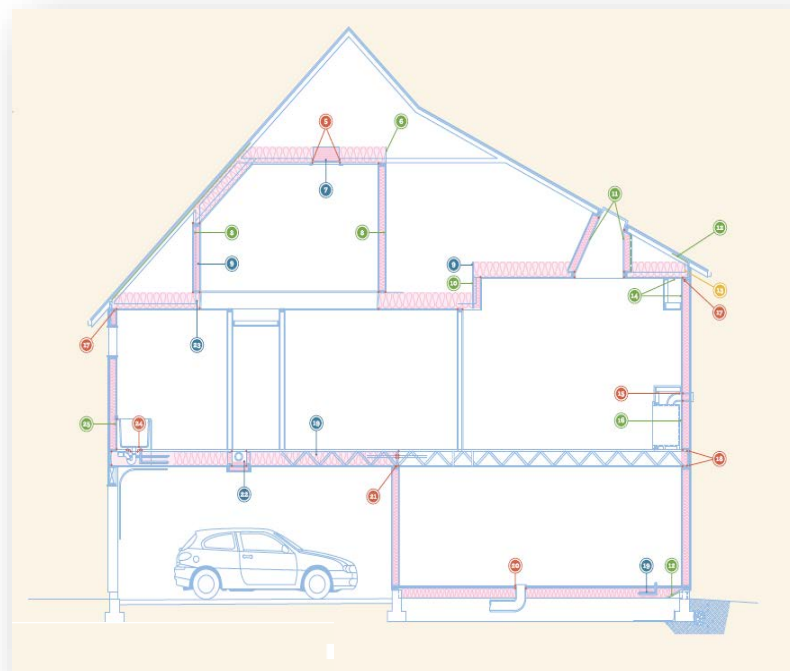
- ☐ Showers and Tubs
- ☐ Fireplaces
- ☐ Attic Knee Walls
- ☐ Skylight Shaft Walls
- ☐ Adjoining Porch Roof
- ☐ Staircase Exterior Walls
- ☐ Double Walls
- ☐ Rim/Band Joists
- ☐ Other Exterior Walls

## Floors

- ☐ Floors Above Garage
- ☐ Cantilevered Floor
- ☐ Unconditioned Floor (Basement/Crawl Sp.)

## Ceilings

- ☐ Dropped Ceiling/Soffit at Unconditioned Attic
- ☐ Other Ceilings



# Air Barrier Example: Attic Knee Wall



No rigid backing on knee wall.



Rigid backing installed prior to insulation.

# Air Barrier Example: Garage Rim Joist



No air barrier is present between garage and conditioned space.



Air barrier is present between garage and conditioned space.



# Air Barrier Example: Wall Adjoining Porch Roof



No air barrier between porch attic and conditioned space.



Air barrier is installed prior to porch attic framing.



# Zero Energy Ready Home Training

Zero Specifications  
Optimized Enclosure  
Insulation System

## High-R Walls

- **Advanced Framing**
  - Thicker Wall
  - Staggered Studs
  - Double Wall
- **Rigid Insulation Exterior Sheathing**
  - With Sheathing
  - Without Sheathing
  - With Extended Plate and Beam
  - With Structural Engineered Panel
- **Systems Building**
  - Structural Insulated Panels (SIPs)
  - Insulated Concrete Forms (ICFs)
  - Insulated Concrete Panels (ICPs)
  - Precast Concrete

- R-17 – R-21 (U 0.052-0.060)
- Higher Framing Factor (~12-15%)
- Blanket Insulation Issues:
  - R-19 is 6" Thick, Compressed is R-17
  - R-21 is 5.5" Thick, Uncompressed is R-21
- Blown-In Insulation Issues:
  - Settling
  - Proper Density (Bag Count)
- Spray Foam Issues:
  - High Cost
  - Closed Cell Enhances Structure Perf.
  - Still Need to Ensure Quality installation



# Adv. Framing: Staggered Studs

- 2x6 plates with 2x4 staggered studs at 12"/24" o.c.
- Reduces thermal bridging by 80-90%
- Cost competitive with traditional 2x6 wall
- Need to ensure spacing between studs okay for deflection



- R-26 Walls ( $U \sim 0.034$ )
- Studs Offset or Separated for Complete Thermal Break
- Coldest Outside Sheathing Needs to Ensure Drying
  - Vapor-open designs use higher-perm sheathing such as plywood or exterior-grade gypsum board
  - Modeling needed to assure moisture control
  - Class I Vapor Retarder (e.g., air-tight drywall)
- Same Framing Techniques Already Understood by Trades





# Getting to Class III Vapor Retarders

<i>Climate Zone</i>	<i>Class III vapor retarders permitted for:</i>
<b><i>Zone Marine 4</i></b>	Vented cladding over OSB Vented cladding over plywood Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value $\geq$ R2.5 over 2x4 wall Insulated [foam] sheathing with R-value $\geq$ R3.75 over 2x6 wall
<b><i>Zone 5</i></b>	Vented cladding over OSB Vented cladding over plywood Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value $\geq$ R5 over 2x4 wall Insulated [foam] sheathing with R-value $\geq$ R7.5 over 2x6 wall
<b><i>Zone 6</i></b>	Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value $\geq$ R7.5 over 2x4 wall Insulated [foam] sheathing with R-value $\geq$ R11.25 over 2x6 wall
<b><i>Zones 7 and 8</i></b>	Insulated [foam] sheathing with R-value $\geq$ R10 over 2x4 wall Insulated [foam] sheathing with R-value $\geq$ R15 over 2x6 wall

## How Much Rigid Insulation Thickness:

Climate Zone	Min. R-Value Foam Sheathing	
	2x4 Walls	2x6 Walls
1-4 Except Marine	Any	Any
Marine 4	R-2.5	R-3.75
Zone 5*	R-5	R-7.5
Zone 6*	R-7.5	R-11.5
Zone 7 and 8*	R-10	R-15

\* Exempt from Class 1 Vapor Retarder; Class III okay (e.g., Latex Paint)

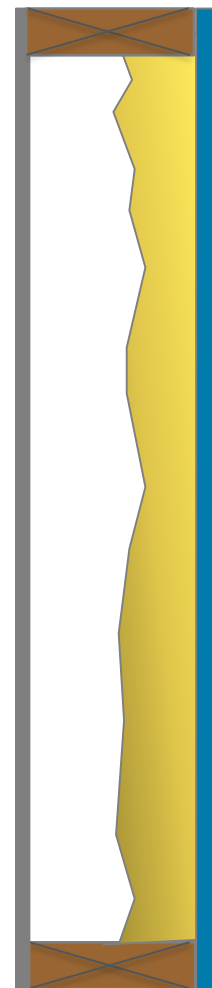
Source: IRC 2007 Supplement, Table N1102.5.1

- R-18 Wall (U 0.054)
- Complete Thermal Break
- Condensation Surface Outboard Structure
- Can Combine Sheathing w/ Weather Resistant Barrier
- Installation Issues:
  - $\leq 1.5''$  Thick, Nails Okay
  - $> 1.5''$  Thick, Screws Needed



# Rigid Insulation w/o Sheathing

- R-17-R-28 Wall
- Complete Thermal Break
- Enhanced Racking Strength and Impact Resistance with CCSpf Enables No Sheathing
- Rigid Insulation Sheathing serves as Weather Resistant Barrier w/Liquid Membrane at Joints and Pan Flashing
- Class III Vapor Barrier (Latex Paint)
- Substantially Reduced Framing including Single Plates
- Engineered Stamped System
- Cost Competitive



- R-18 Wall
- 2x4 Studs with 2x6 Plates
- Sheathing Attached to Plates for Near Full Racking Strength
- Complete Thermal Break Except for Top and Bottom Plates
- Condensation Surface Inside Assembly, so Must Control Air Flow
- Cladding Attachment Simplified if Permissible to Nail to Sheathing





# Rigid Insulation w/Engineered Panel

- Innovative & Affordable
- Based on the perfect wall, using a “studless” structural engineered panel
- Single water, air, and vapor control layer
- Recent experience has demonstrated it can be built for less than a standard wood-frame wall system





# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy




Step 1: Build the entire structure including foundation, floor systems, walls, and roof



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Step 2: Wrap the entire envelope with a  
“peel & stick” membrane integrated with  
openings / penetration



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Step 3: Add rigid foam insulation  
2 to 3" on foundation  
3 to 4" on walls  
6 to 8" on the roof



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Step 4: Add furring strips, overhangs, etc.



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Step 5: Install trim; siding; roof sheathing  
and roofing



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Rigid Insulation w/Engineered Panel

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Structural Insulated Panels (SIPs)

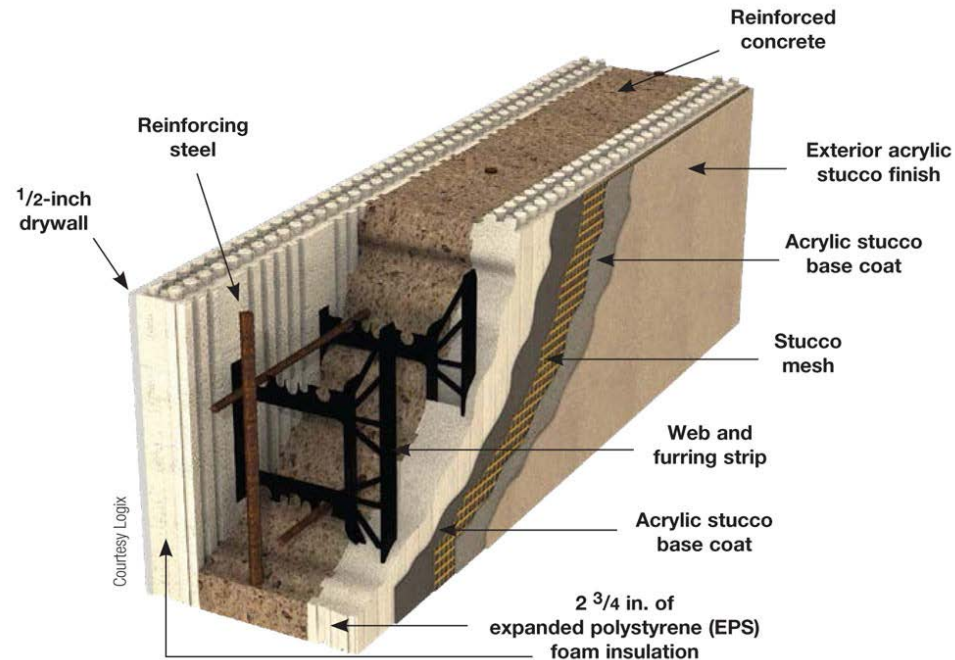
- R-26 Walls (6") (U 0.034)
- Substantial Thermal Break (3 – 8% Framing Factor)
- Special Construction Practices Required
- Foundation has to be Perfectly Level
- Significantly Reduced Time-of-Construction
- Reduced Dimensional Variation Corrections
- Killer Applications





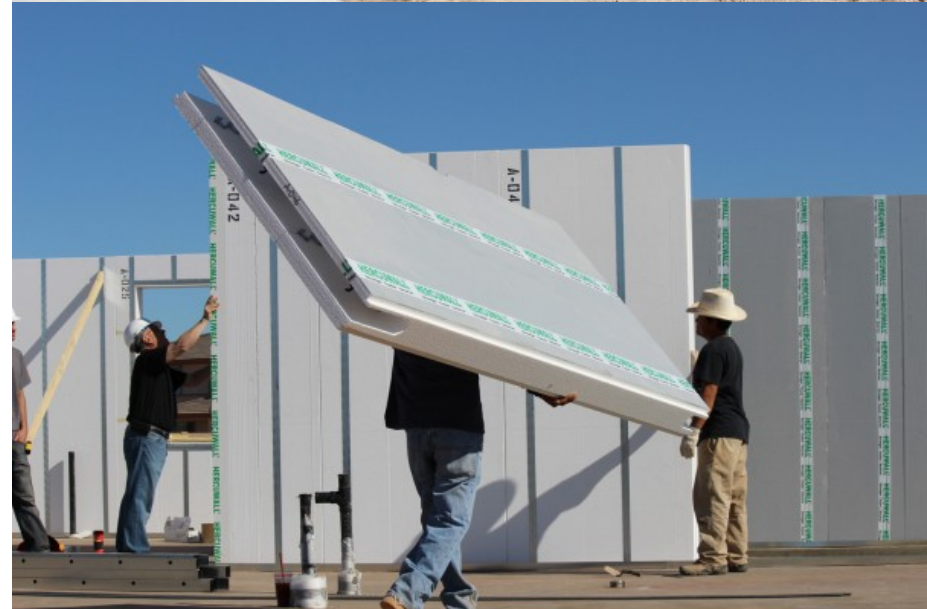
# Insulated Concrete Forms (ICFs)

- ~R-24 Walls (U 0.038)
- Complete Thermal Break
- Useful Thermal Mass
- Foundation has to be Perfectly Level
- Longer Time-of-Construction
- Maximum Disaster Resist.
- Termite Resistant
- Reduced Dimensional Variation Corrections
- Much More Costly



# Insulated Concrete Panels (ICPs)

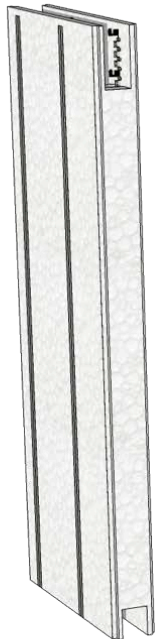
- ~R-24 Walls (U 0.038)
- Complete Thermal Break
- Useful Thermal Mass
- Foundation has to be Perfectly Level
- Significantly Reduced Time-of- Construction
- Maximum Disaster Resist.
- Termite Resistant
- Reduced Dimensional Variation Corrections
- Cost Competitive





# ICP Installation Steps

## 1 Panels As Delivered





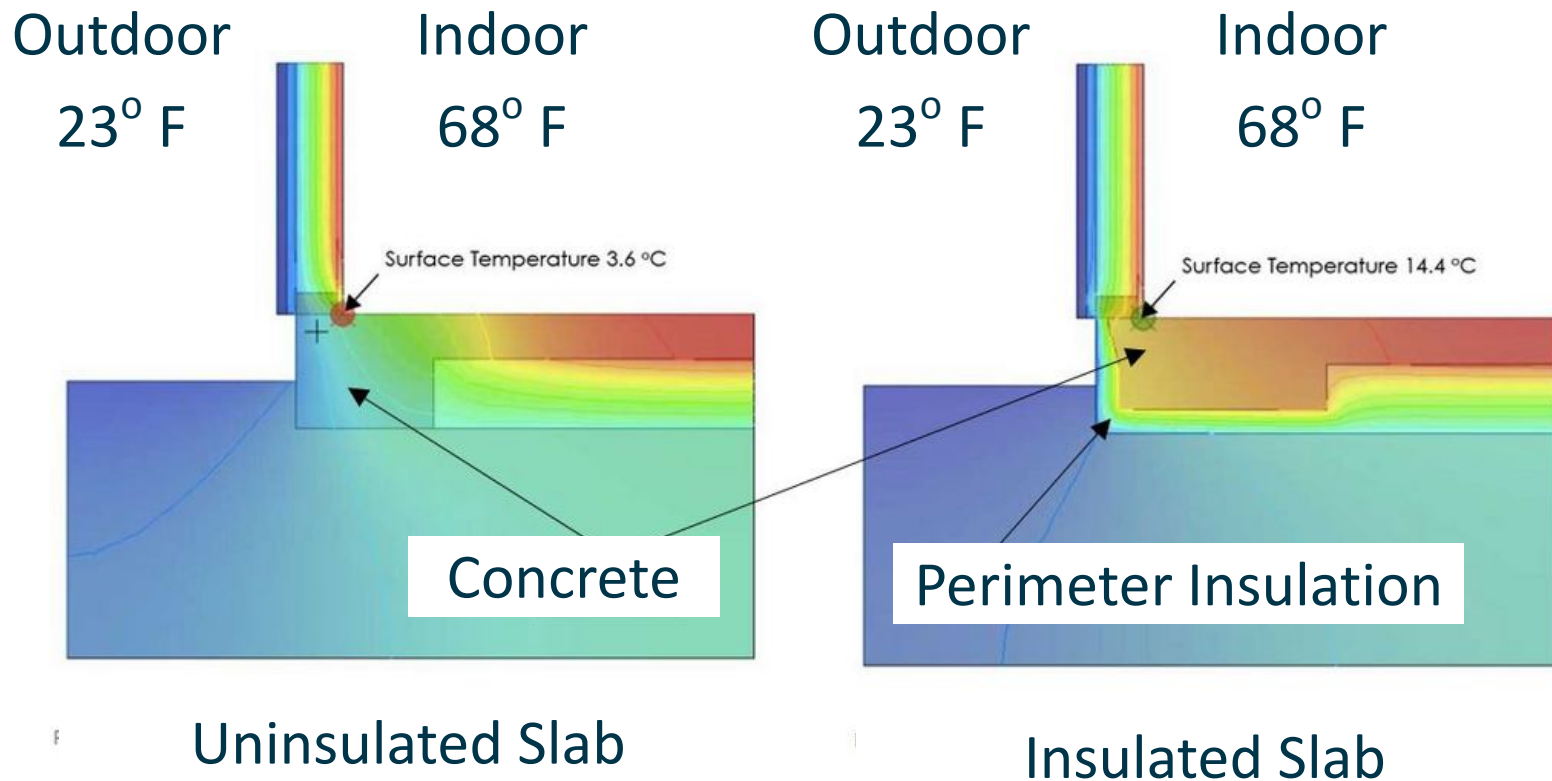
## Zero Energy Ready Home Training

Zero Specifications  
Optimized Enclosure System  
Insulation System

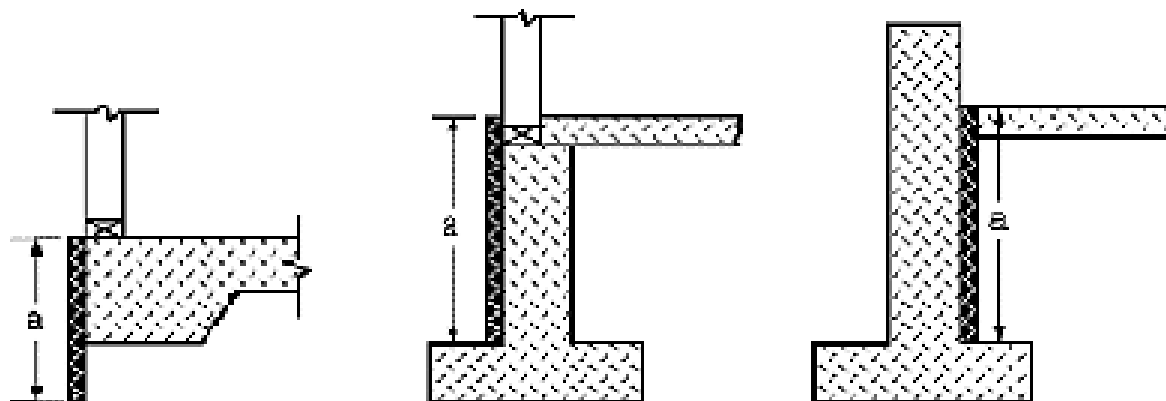
# High-R Foundation

# High-R Foundation

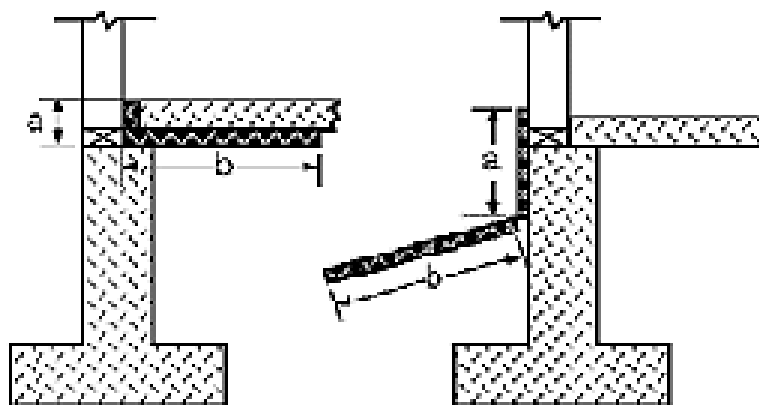
## Why Slab Insulation Important



# High-R Foundation: Slab Edge Insulation Options

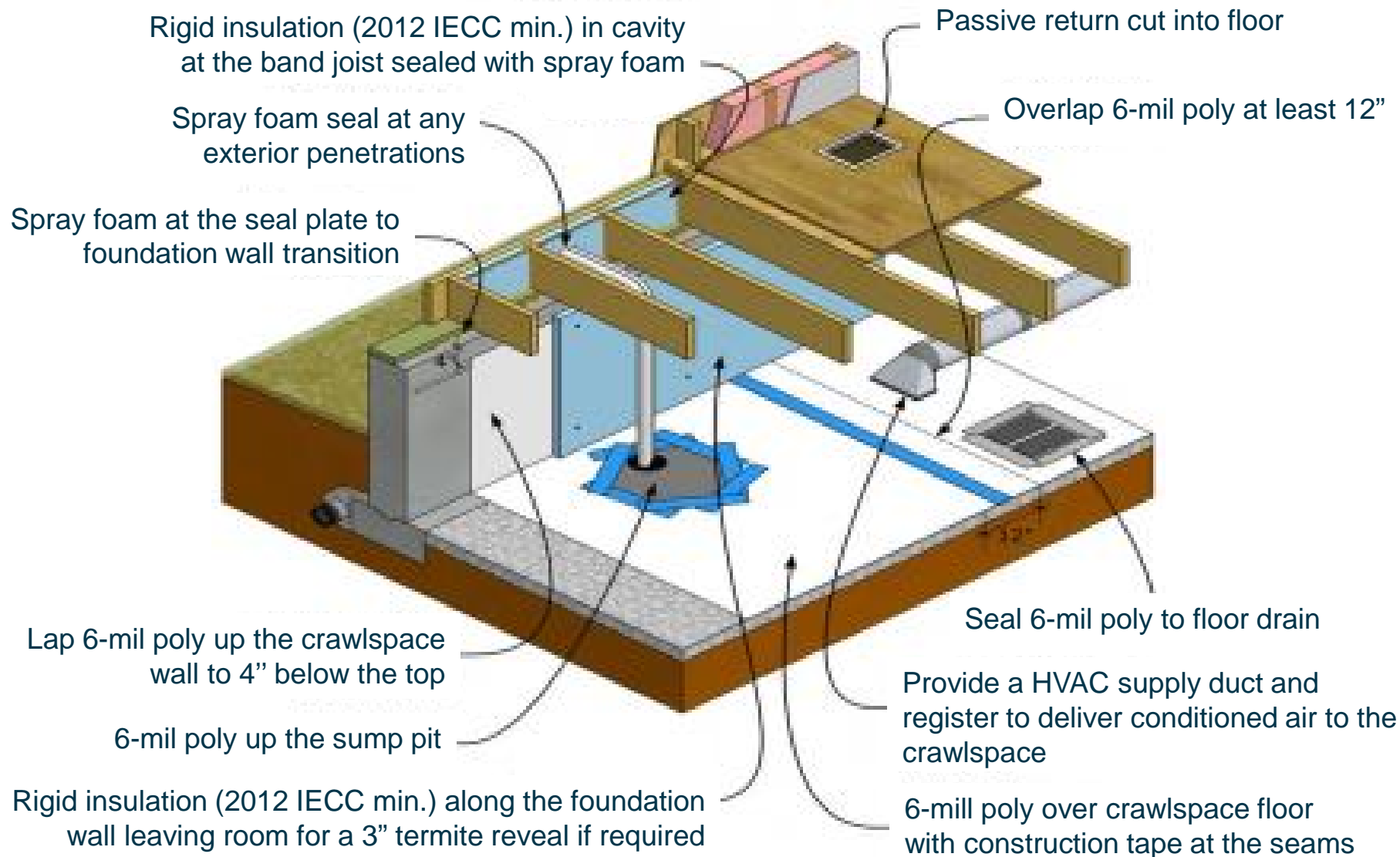


$a$  = insulation depth



$a + b$  = insulation depth

# High-R Foundation: Unvented Crawlspace





- Flood Zone Areas
- Raised Pier Foundation with No Walls
- Dry Climates per 2009 IECC
- Marine Climates per 2009 IECC Where No Air Handler or Return Ducts

**Note:** Vented crawl space will have floor insulation per 2012 IECC installed to RESNET Grade 1

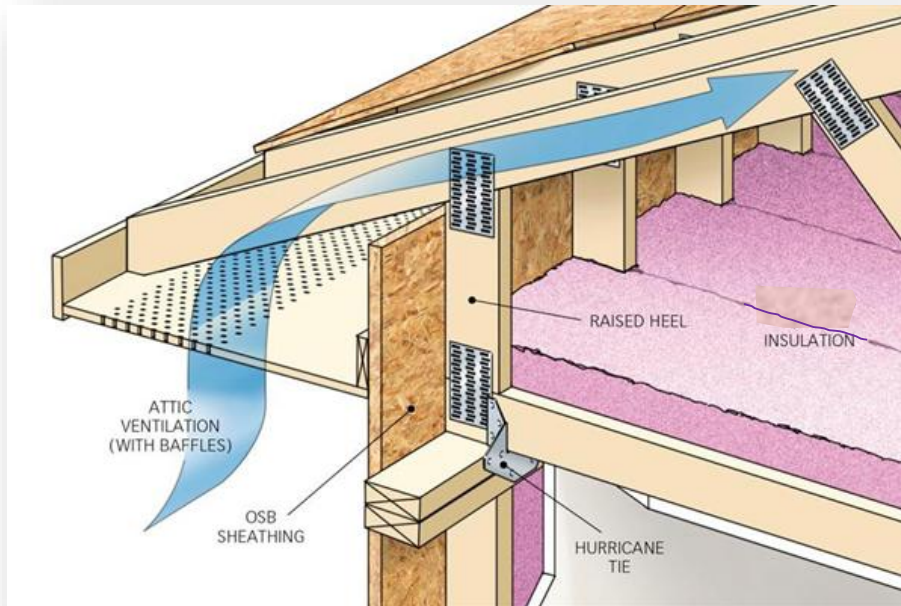


# Zero Energy Ready Home Training

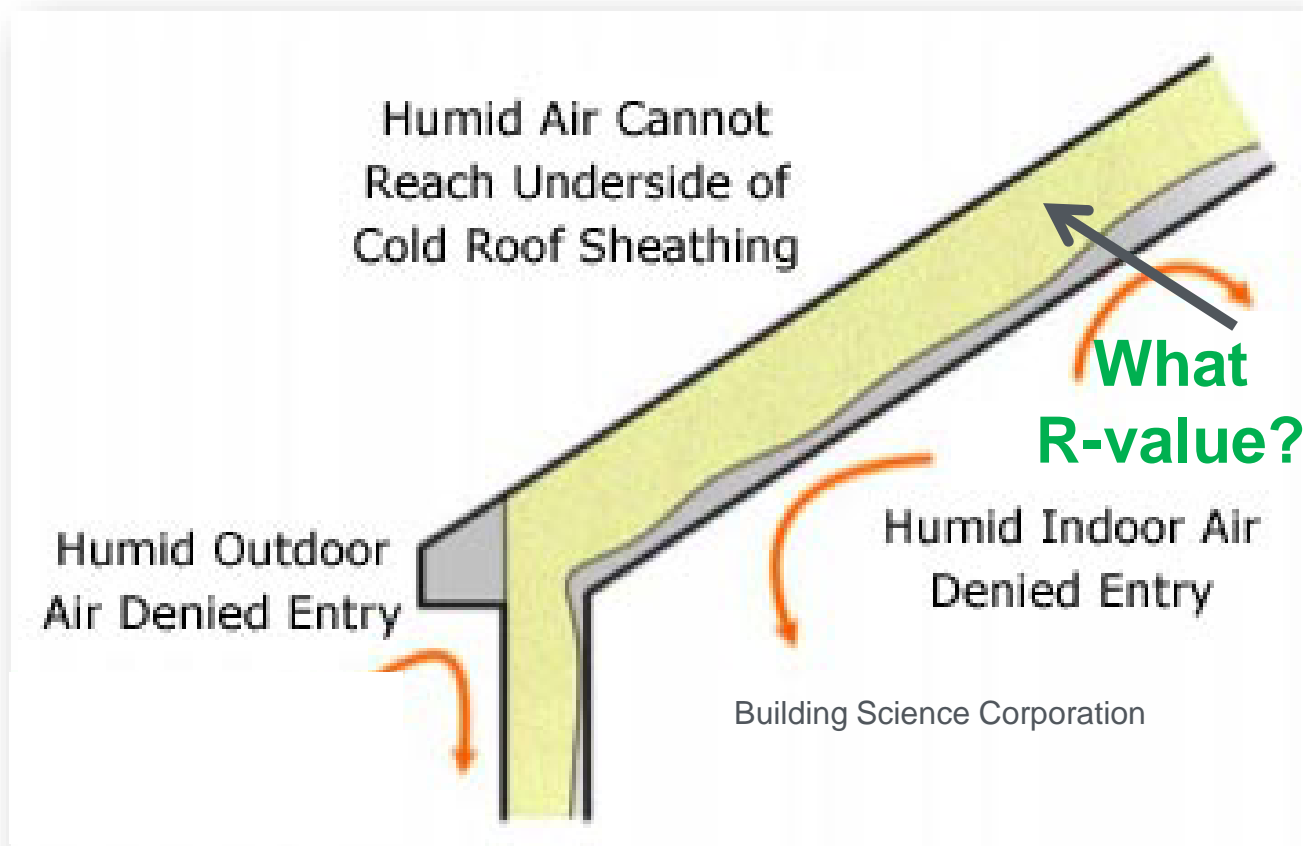
Zero Specifications  
Optimized Enclosure  
Insulation System

## High-R Roof

# High-R Roof Insulation at Flat



## 5.1 AIR-IMPERMEABLE: In direct contact with the underside of the sheathing



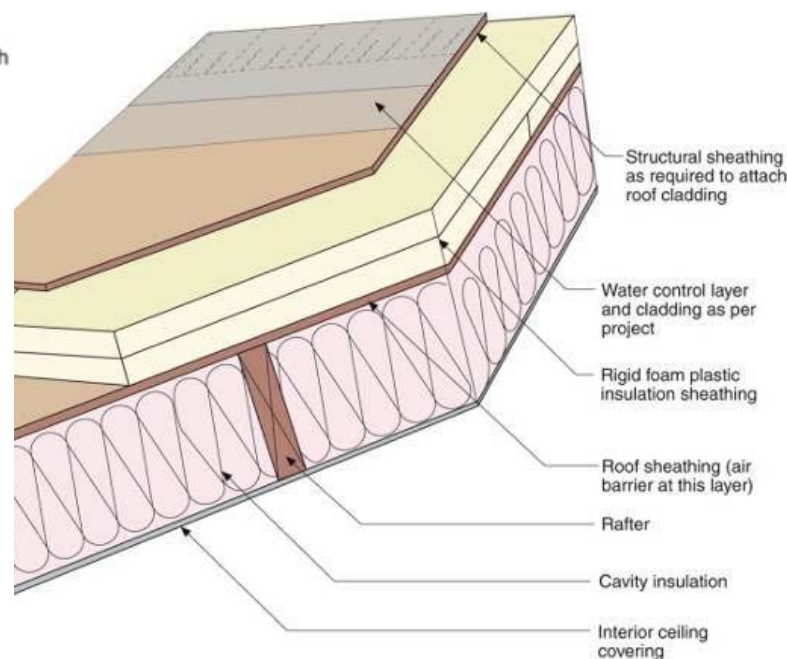
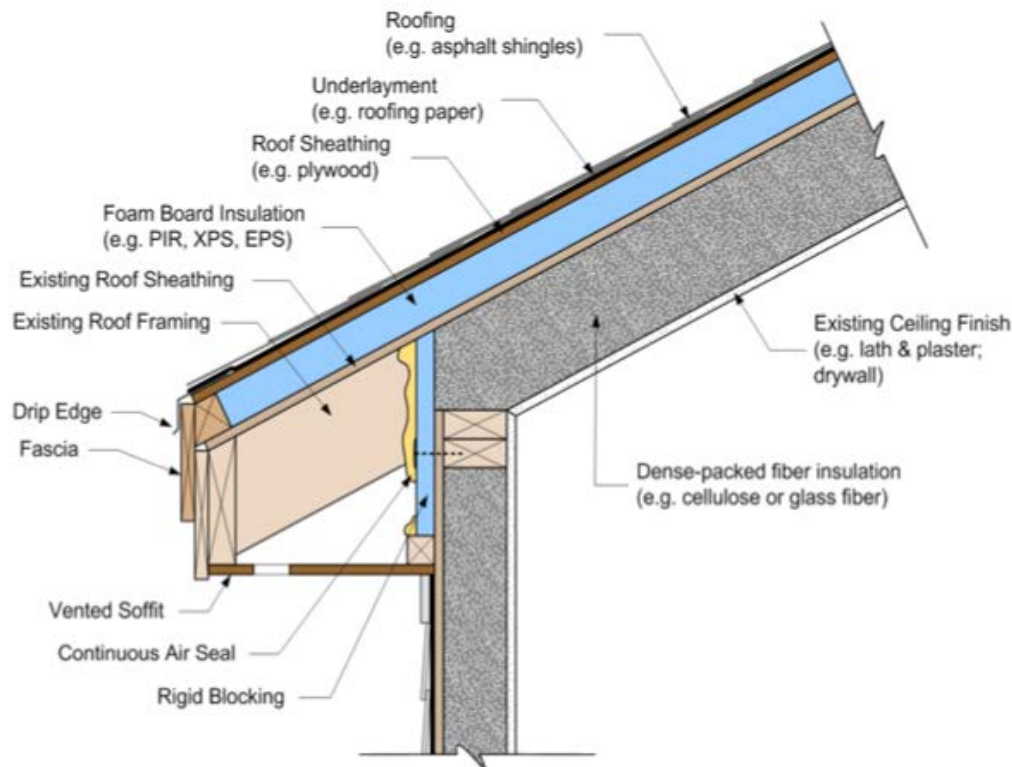
## Minimum R-value of Impermeable Insulation

Climate Zone	Minimum Impermeable Insulation R-Value*	2012 IECC Ceiling R-Values
2B and 3B Tile Roof	None Required	30
1, 2A, 2B, 3A, 3B, 3C	R-5	38
4C	R-10	38
4A, 4B	R-15	49
5	R-20	49
6	R-25	49
7	R-30	49
8	R-35	49

\*contributes but doesn't supersede 2012 IECC insulation requirements



# Top Insulated Roof Deck



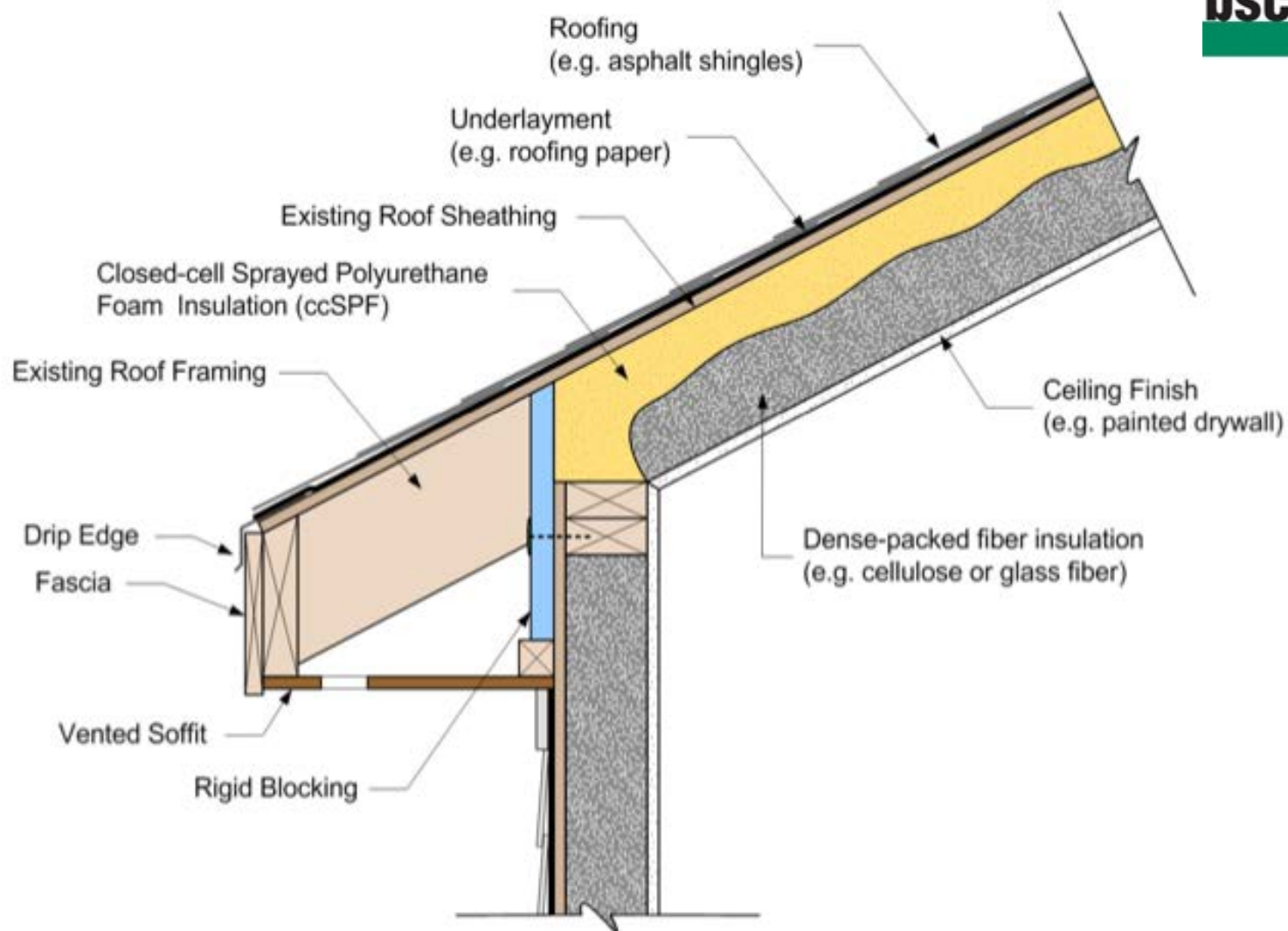
## Sequence of Retrofit:

- 1) Remove existing roofing and underlayment; Inspect existing roof deck and framing and repair as necessary.
- 2) Install new exterior foam board insulation, roof sheathing, underlayment, flashings and roofing.
- 3) Remove existing soffit and install rigid blocking to prevent loose-fill fiber insulation from blowing into soffit; Install continuous air seal at all joints and interfaces in blocking; Replace soffit.
- 4) Dense-pack rafter cavities using approved cellulose or glass fiber insulation and following insertion tube techniques described in BPI RBE-WHALCI 2012.

# Why Two Layers Rigid Foam



# Guidance for Dense Pack Roof





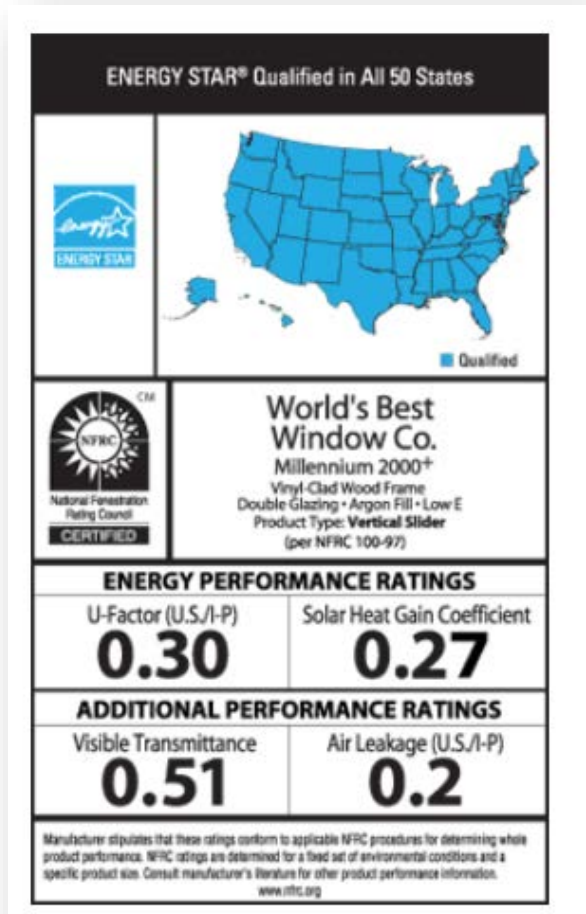
# Zero Energy Ready Home Training

Zero Specifications

Optimized Enclosure

# **Advanced Windows**

- Assures beyond-code window performance
- Fenestration used for passive solar design are exempt from the U-factor and SHGC requirements
- Area-weighted averages for U-factor, SHGC permitted



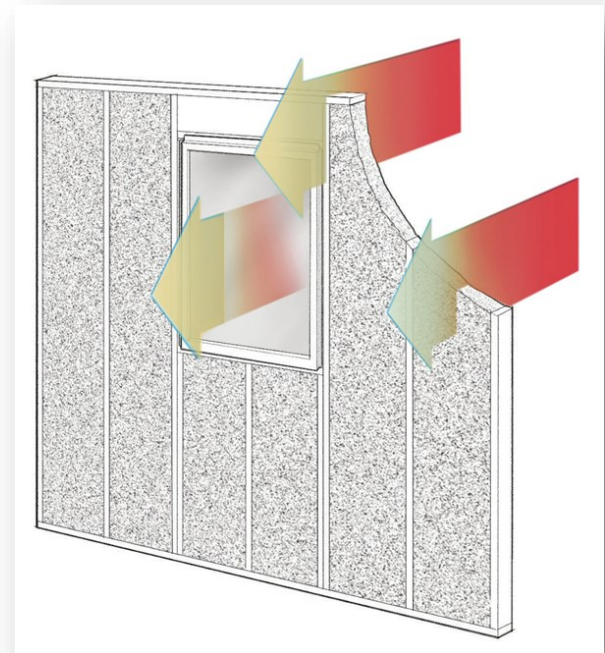


# Good, Better, Best Windows

	Hot Climates IECC CZ 1-2		Mixed Climates IECC CZ 3-4 except Marine		Cold Climates IECC CZ 5-8 and 4 Marine	
	U-value	SHGC	U-value	SHGC	U-value	SHGC
<b>Mandatory:</b> ENERGY STAR	0.40	0.25	0.30	[4] 0.40 [3] 0.25	0.27 0.28 0.29 0.30	Any ≥0.32 ≥0.37 ≥0.42
<b>Performance:</b> Target Home	0.40	0.25	0.30	0.25	0.27	Any
<b>Encouraged:</b> High-R	--	--	0.21	0.25	0.18 - 0.21	Any

# Why Go Beyond ENERGY STAR\*

Window 15% of Wall Area	Wall R-Value with Windows w/Variied Wall Insulation Levels			
U-Value	R-0	R-18	R-39	R-60
0.30	R-5	R-11	R-15	R-17
0.20	R-5	R-13	R-19	R-23
0.15	R-5	R-14.5	R-23	R-28
0.10	R-5.5	R-16	R-27	R-34



## \* In Cold Climates

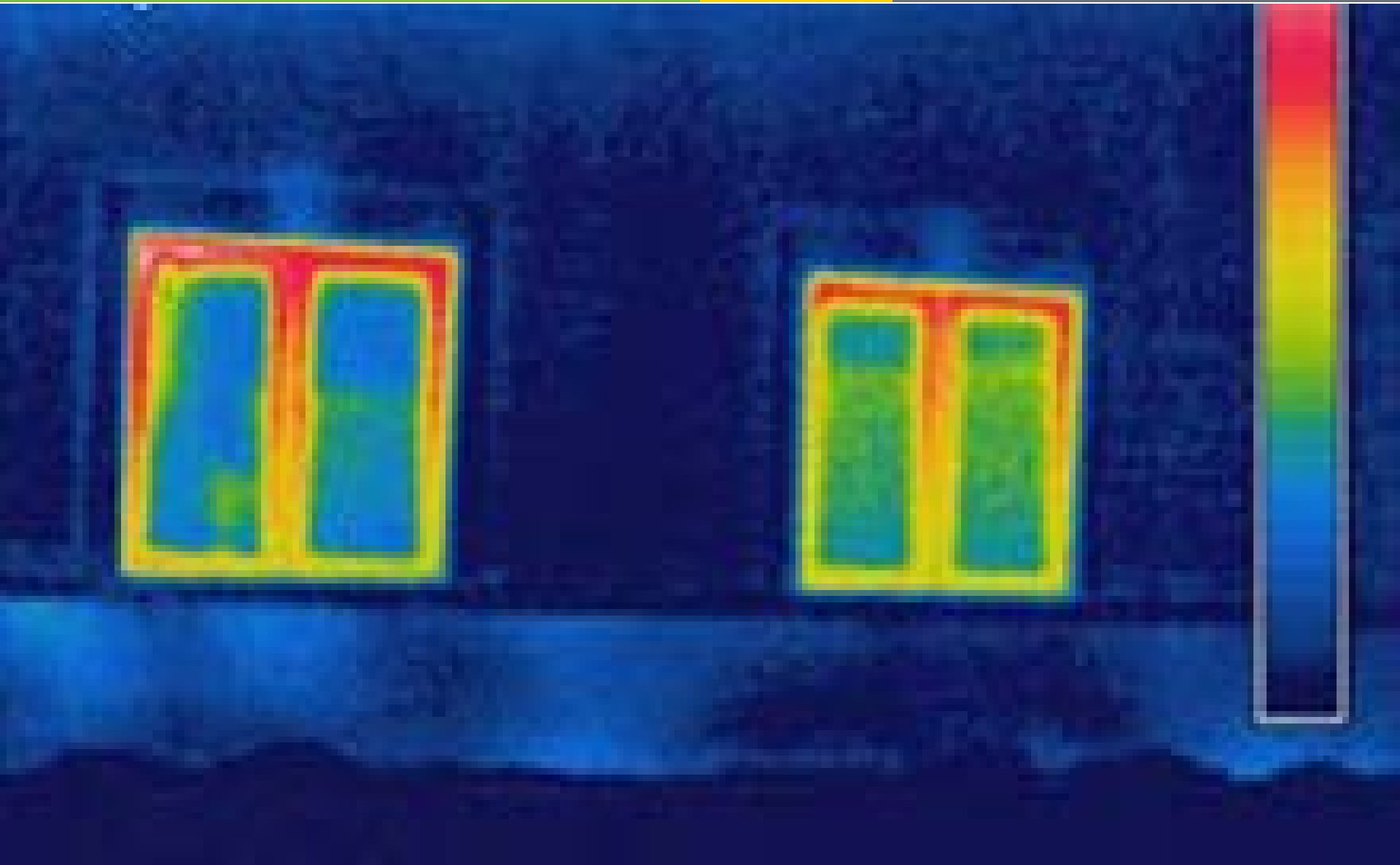
- Sources:**

*“Holes in the Wall: To Improve the Energy Performance of Walls, Look at the Total R-Value,”* Journal of Light Construction, February 2014;

Multi-Assembly R-Value / U-Value Calculator – Cascadia Windows and Doors;

Michael Blasnik Presentation, 2014 ACI Conference

# The Biggest Thermal Hole....





Zero Energy Ready Home Training

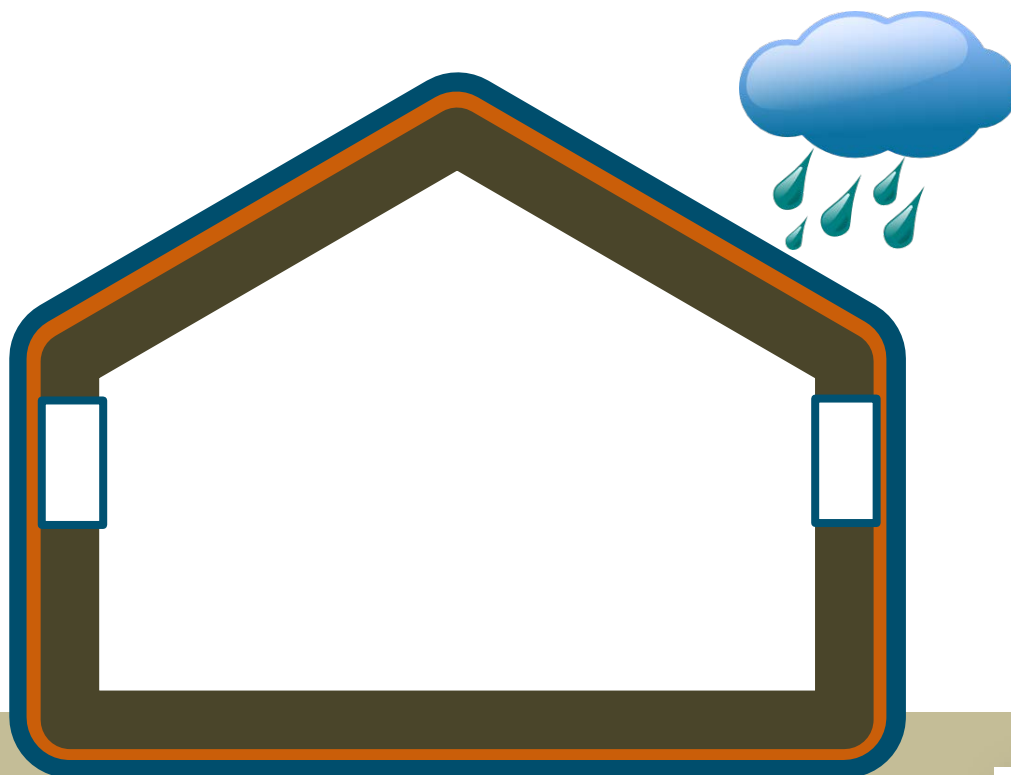
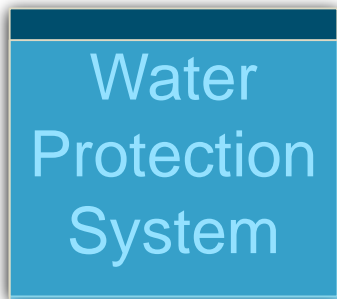
Zero Specifications

**Water Protection**

# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



+



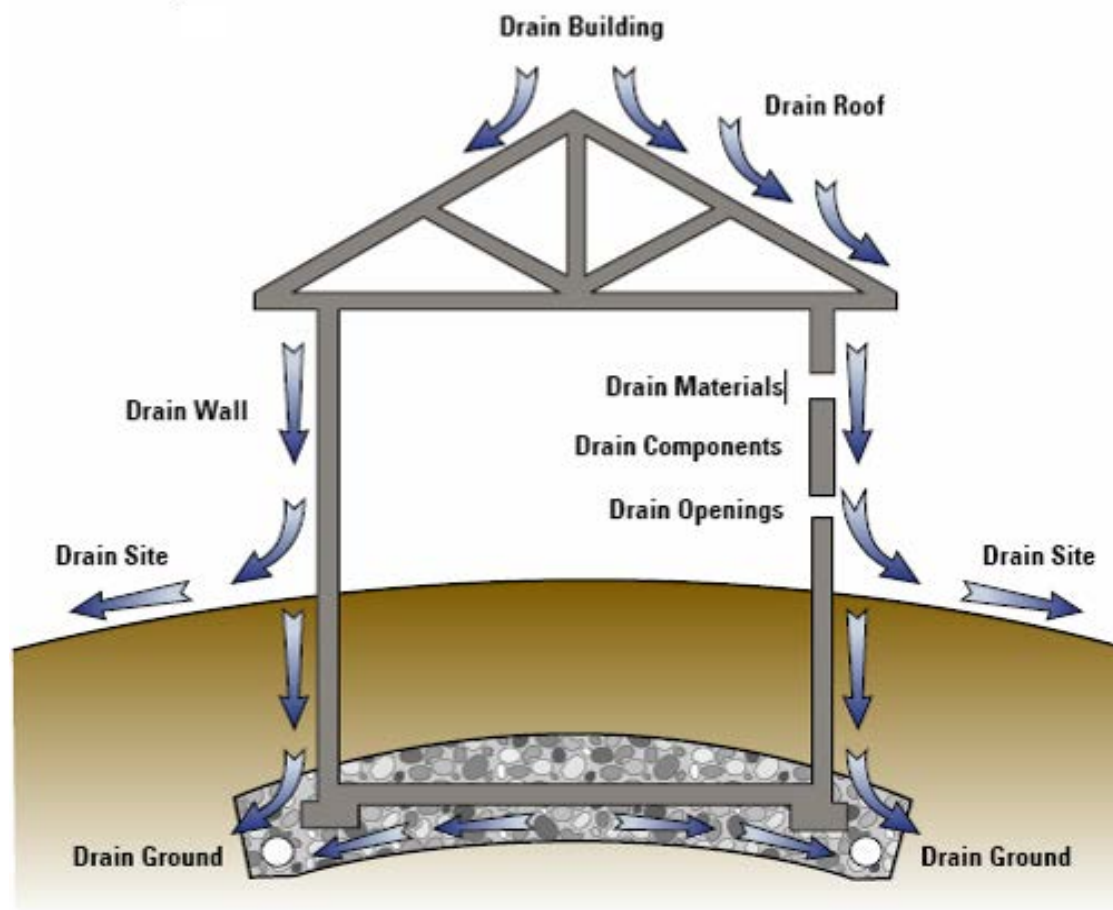
- Sump Pumps
- Flooring Materials
- Sub-Slab Aggregate

=





# Bulk Moisture Control Concept

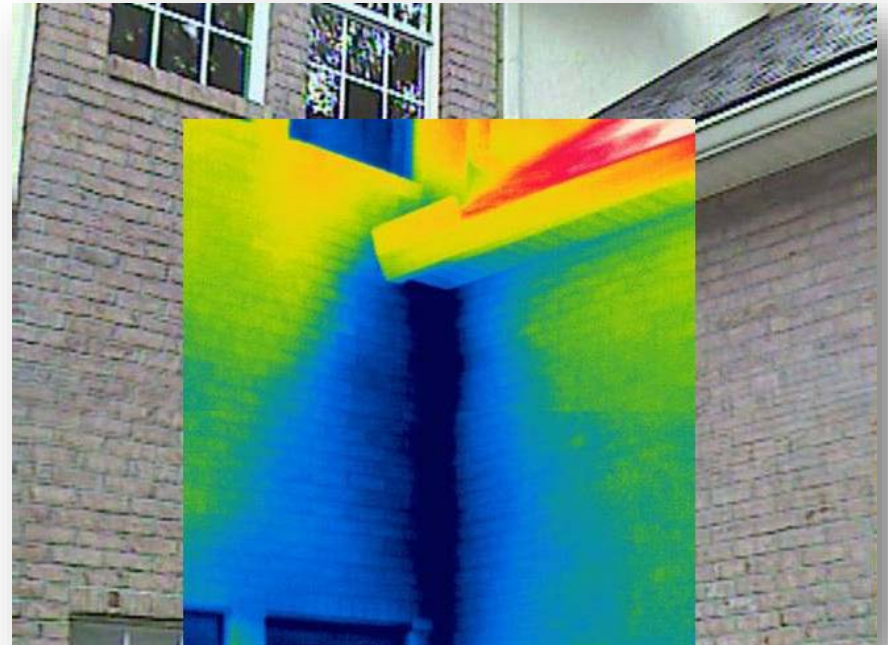


- Weather Resistant Barriers
- Flashing
- Capillary Breaks



Water  
Management

# What We're Trying to Avoid



Missing step & kick-out flashing

# Step & Kick-Out Flashing





Zero Energy Ready Home Training

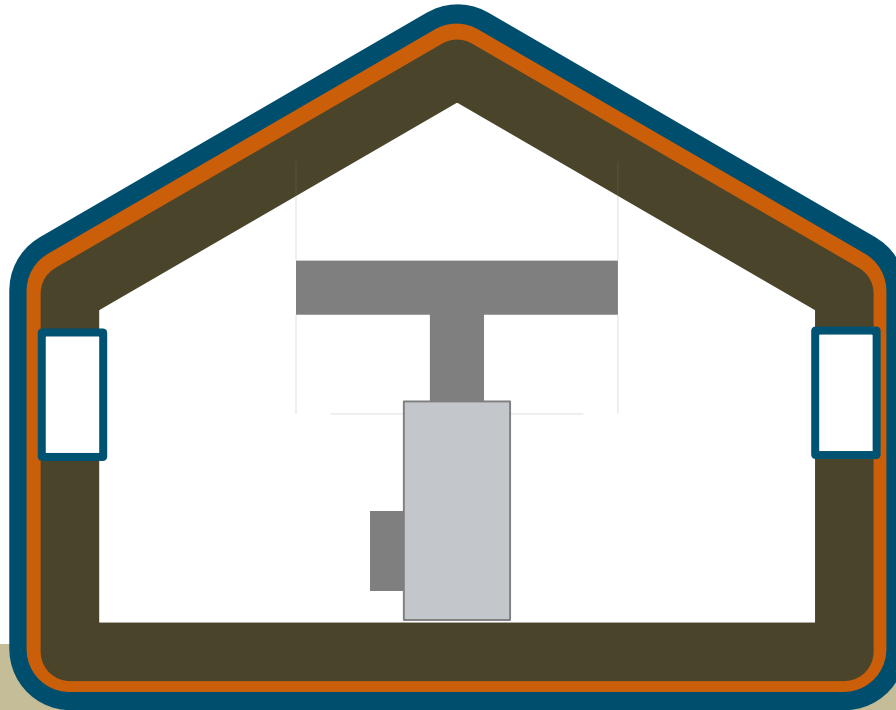
Zero Specifications

**Ensured Comfort**



# Zero Energy Ready Home Spec

Optimized  
Comfort  
System



- Optimized Duct Location
- RH Control In Hot/Humid Climates



- **Quality HVAC Installation:**
  - High efficiency
  - Properly designed and installed
  - Combined with a duct system that's insulated, sealed, and balanced

**... Maintain comfort with less energy.**
- **Ducts in Conditioned Space:**

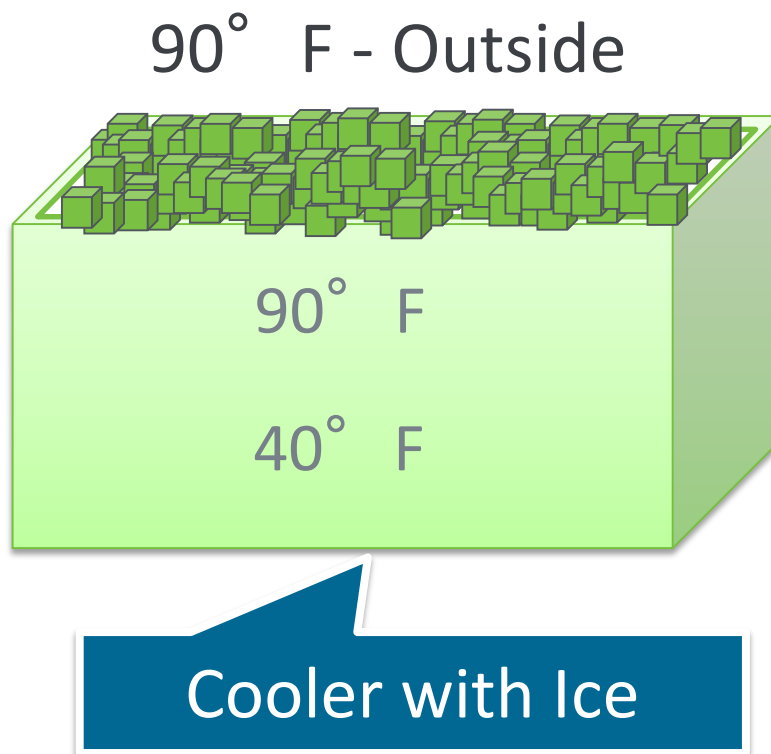


Zero Energy Ready Home Training

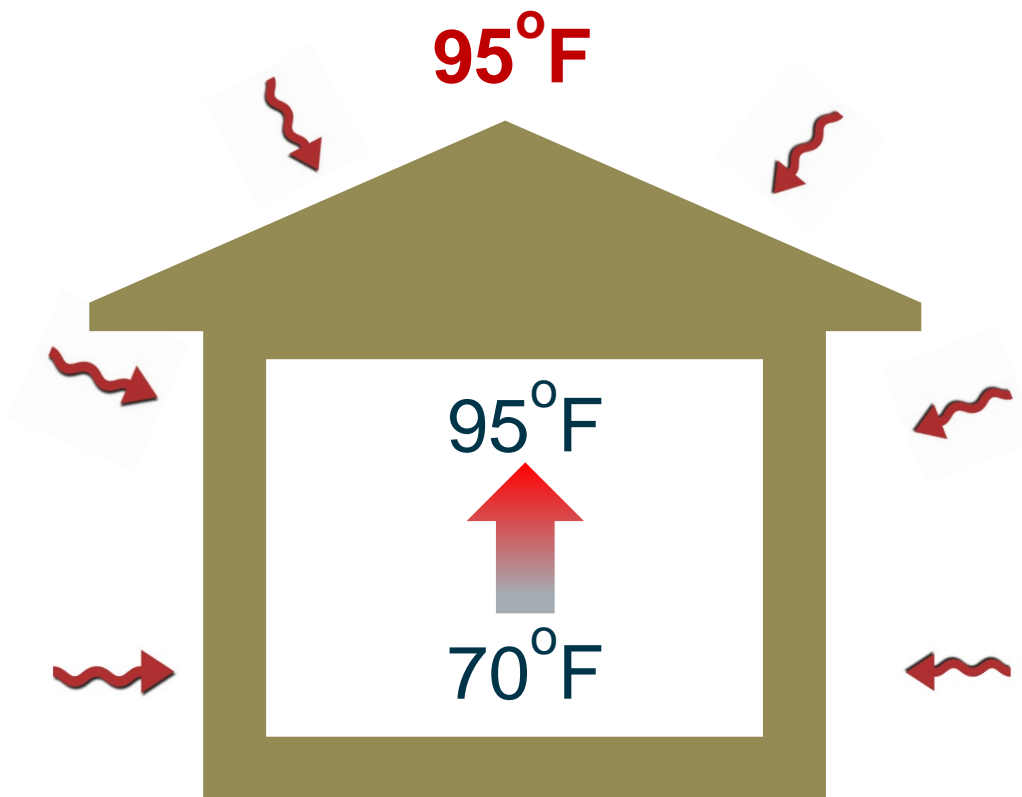
Zero Specifications  
Ensured Comfort

**Quality HVAC Installation**

Energy moves from more to less.



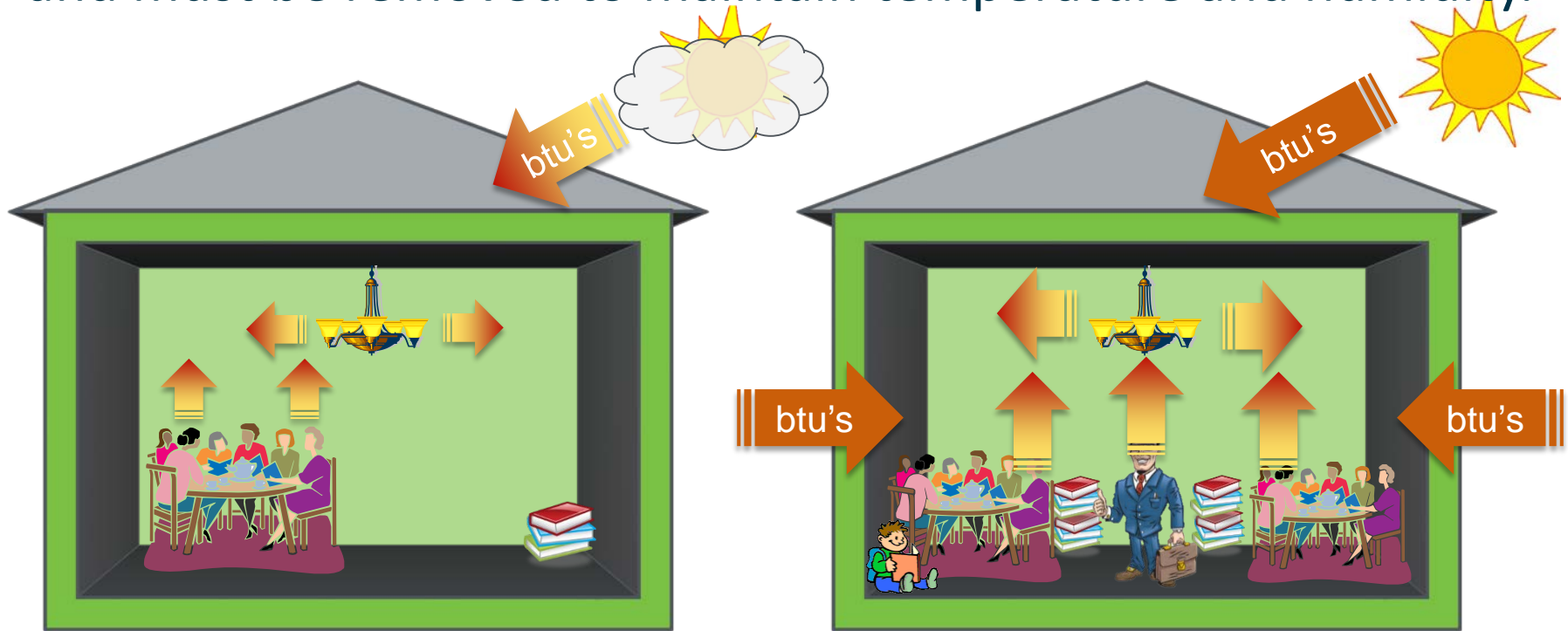
Energy moves from more to less.





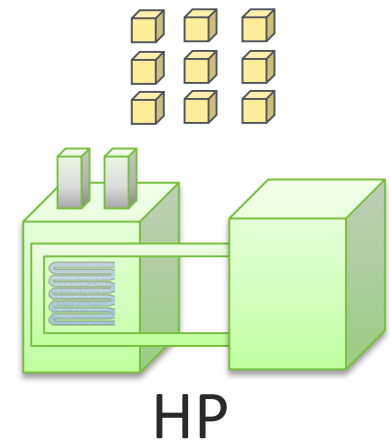
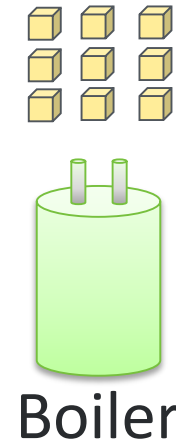
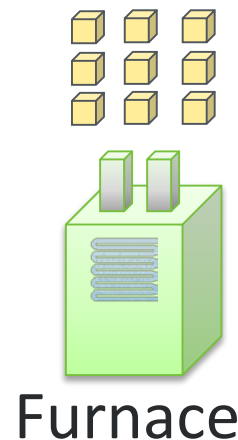
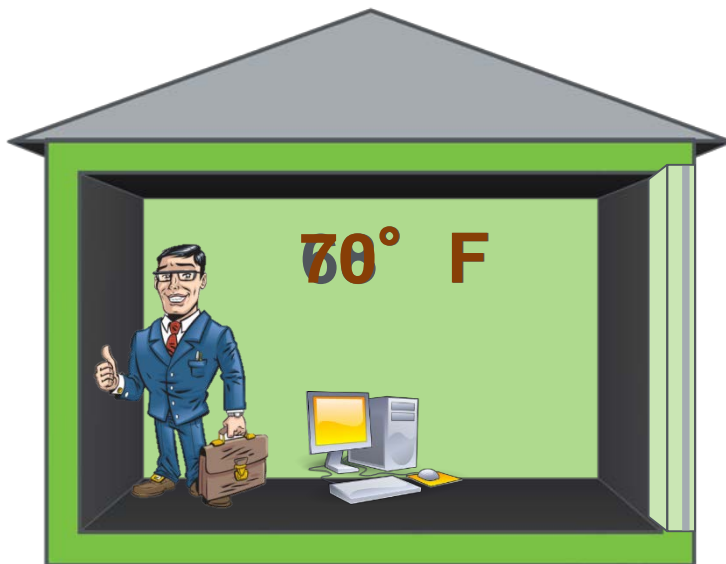
# Calculating Heating & Cooling Load

- Cooling Load varies for each hour of the year.
- Cooling Peak Load: Maximum energy added in a single hour, and must be removed to maintain temperature and humidity.



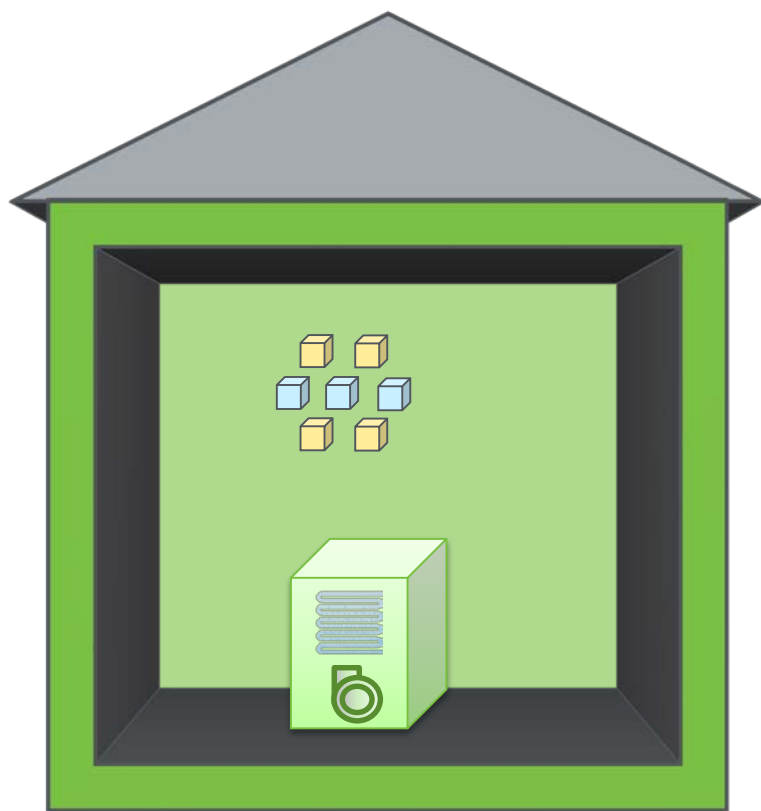
# Calculating Heating & Cooling Load

- Cooling & heating equipment are “btu machines” that add or remove btu’s to offset the load
- Load = number of btu’s equipment has to remove or add
- Load independent of type of equipment used

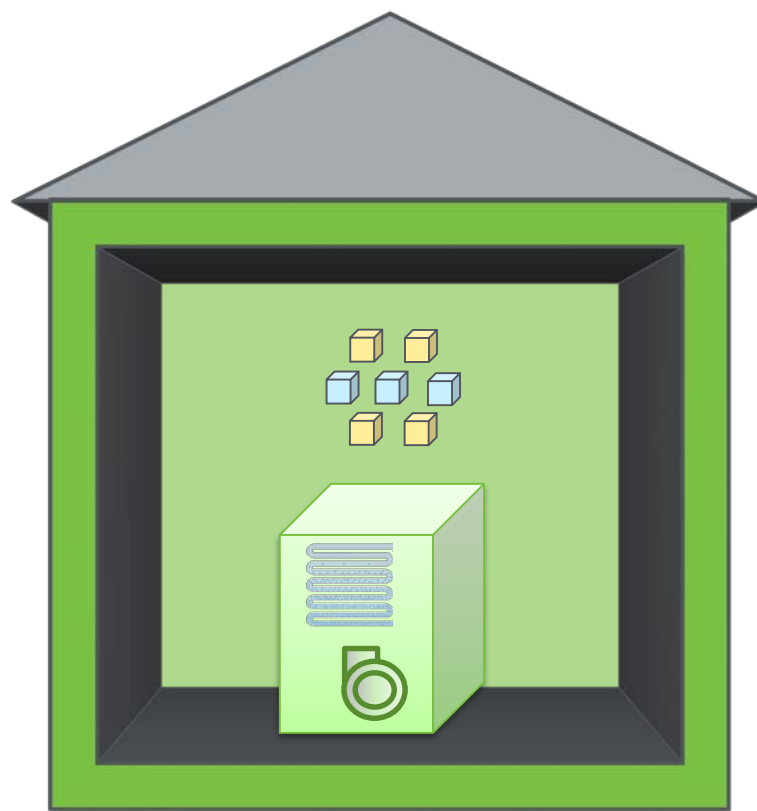


# Select Equipment That Meets Loads

Heating and cooling equipment generally two modes – on & off.



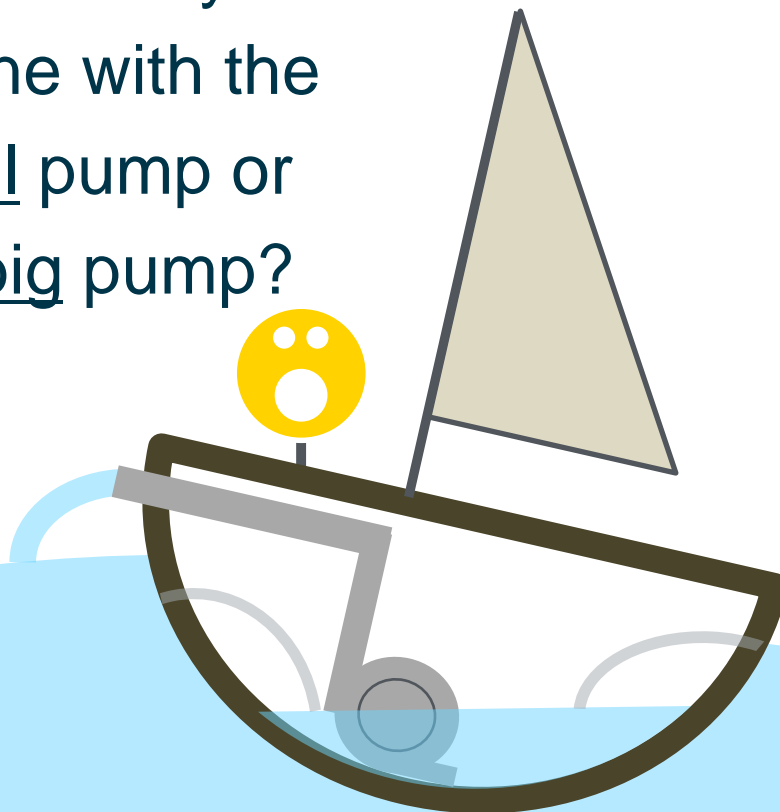
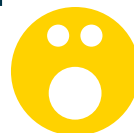
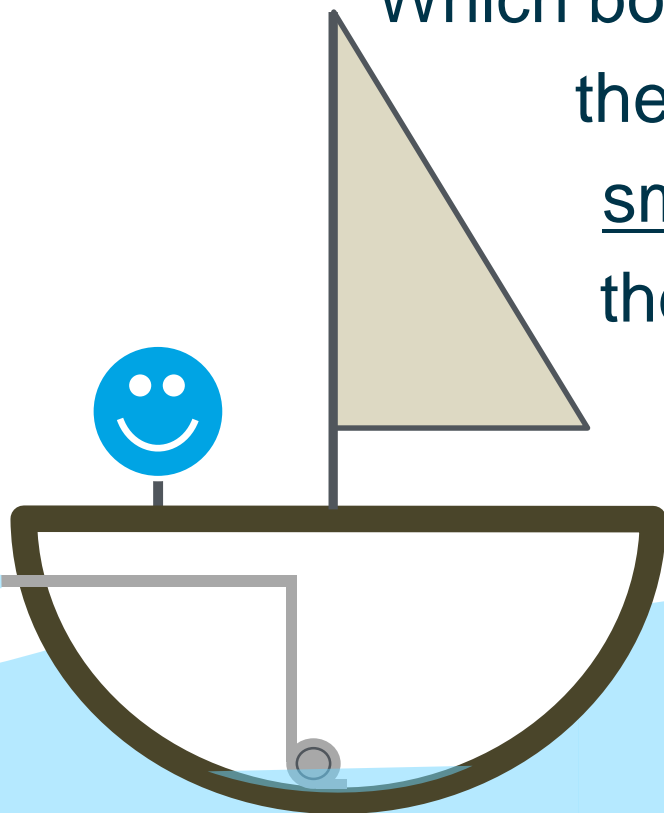
Equipment < Load



Equipment > Load

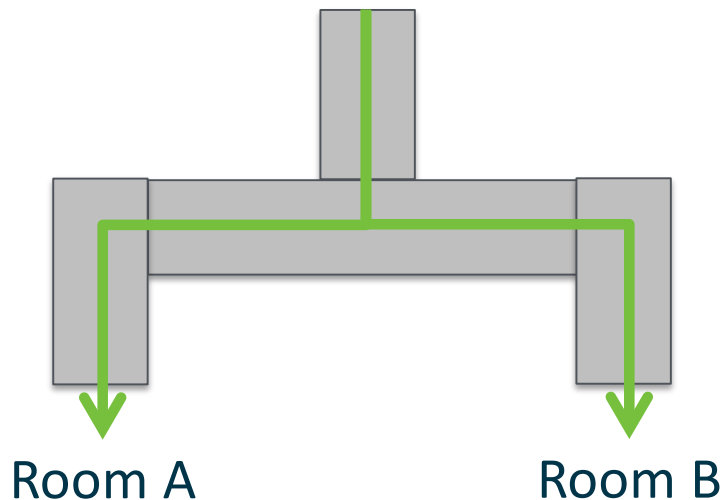
# What We're Trying to Avoid

Which boat would you want -  
the one with the  
small pump or  
the big pump?

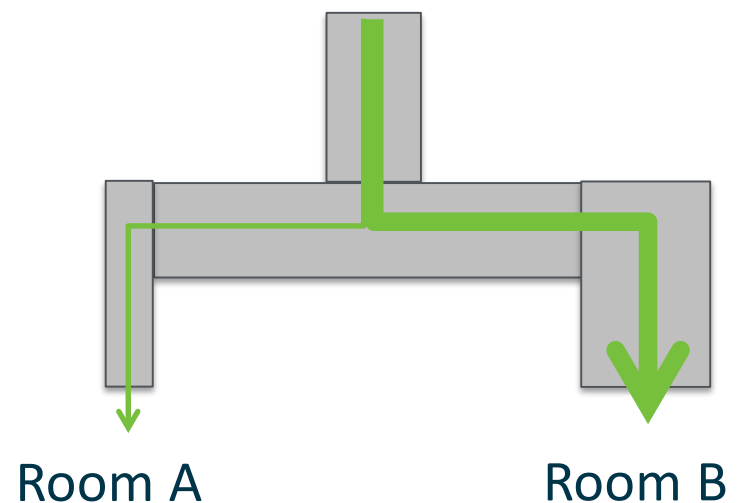


Verify that the equipment capacity  
is right-sized relative to  
the heating and cooling load.

## 1. Air follows the path of least resistance.



Equal resistance,  
equal flow

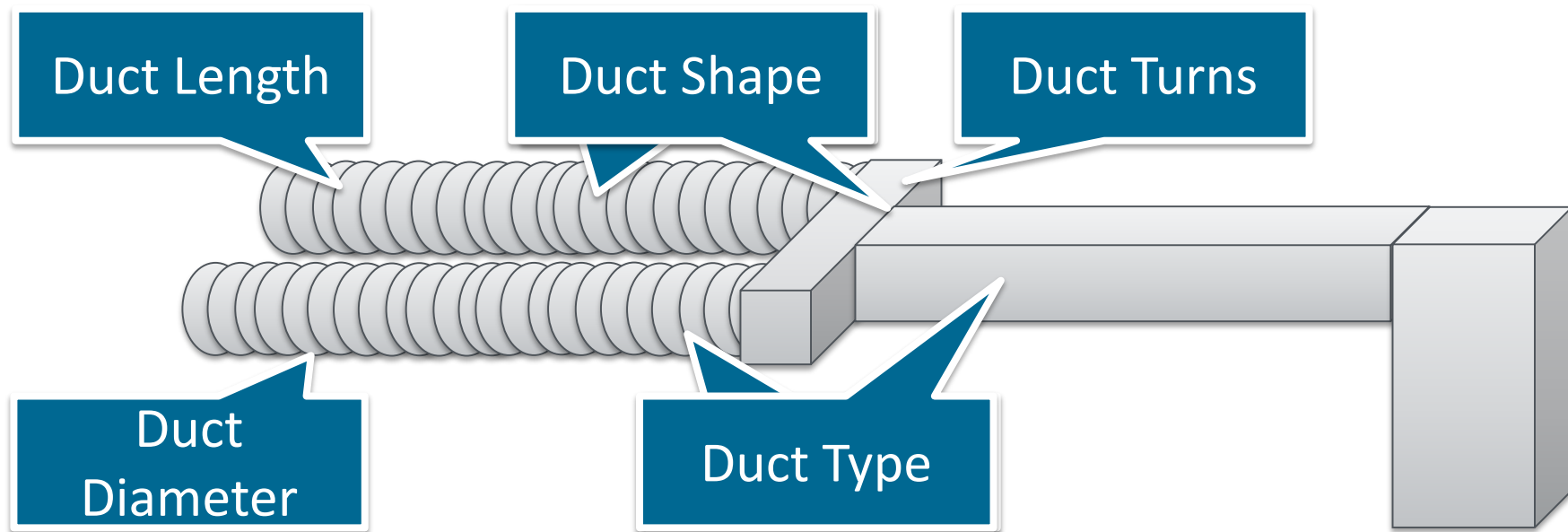


Higher resistance,  
less flow

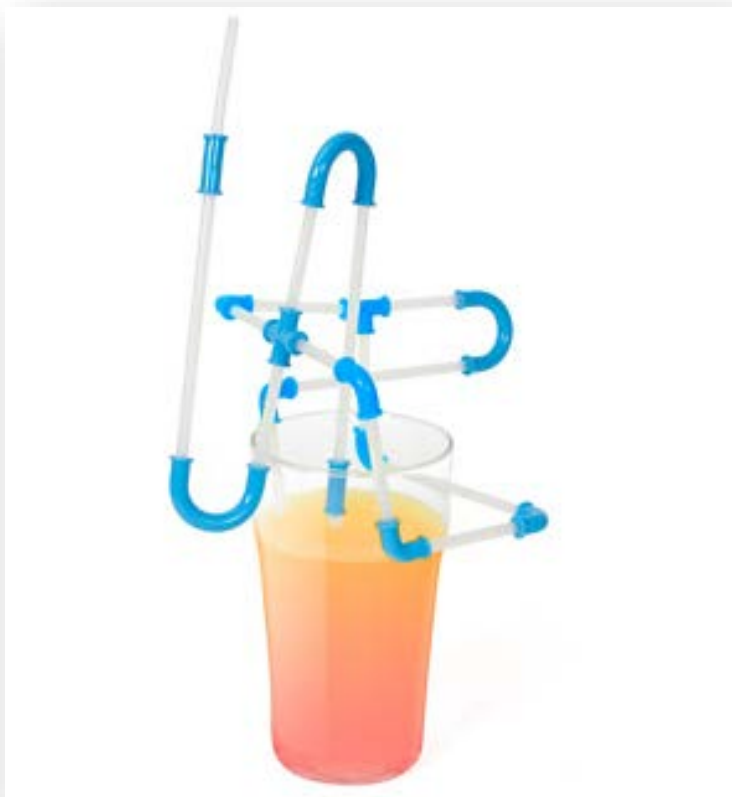


## Factors that influence the airflow of the ducts:

- Duct Length
- Duct Size
- Duct Shape
- Duct Type
- Duct Turns
- Other Components (e.g., Filters)



# What We Are Trying to Avoid



Verify that the ducts are  
balanced, insulated, tight, and  
installed without major defects.

## Design:

1. Calculate Heating/Cooling Loads
2. Select Equipment that Meets Loads
3. Design Duct System that Gets Air from Equipment to Rooms and Back

## Commission:

- A. Check Airflow at Air Handler
- B. Check Refrigerant Charge
- C. Measure Airflow at Registers/Exhaust

**HVAC QI  
Contractor  
Checklist**

**Rater  
Field  
Checklist**



Zero Energy Ready Home Training

Zero Specifications  
Ensured Comfort

# Ducts in Conditioned Space

- **Significant Thermal Losses:**
  - Thermal losses triple for ducts in unconditioned vs. conditioned space
  - Total thermal losses can range from 10-45%
  - Extensive unconditioned space penetrations
- **Significant Performance Impacts:**
  - IAQ
  - Comfort
  - Durability



- **Short Duct Run**

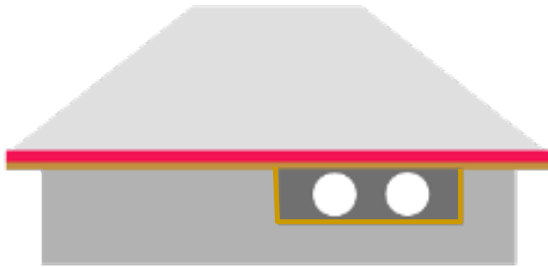
up to 10' of total length is permitted to be outside of the home's thermal and air barrier boundary.

- **Jump Ducts**

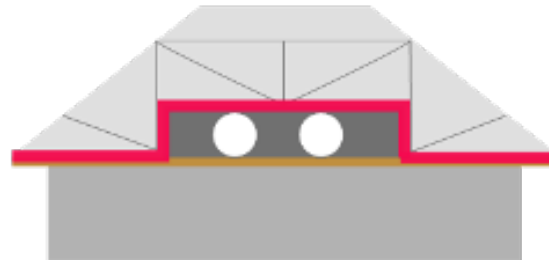
may be located in attics if all joints, including boot-to-drywall, are fully air sealed with mastic

- **Ductless HVAC system**

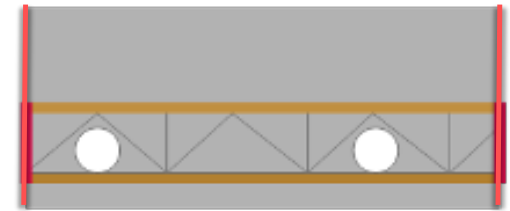
# Ducts in Conditioned Space



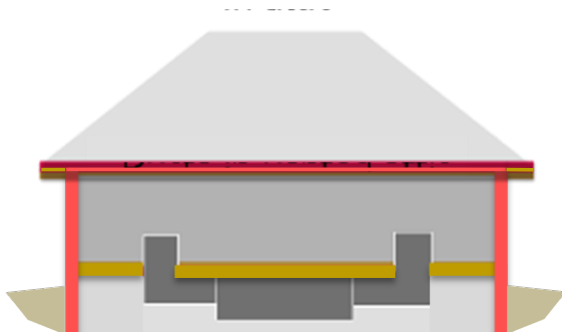
Ducts in Dropped Ceiling



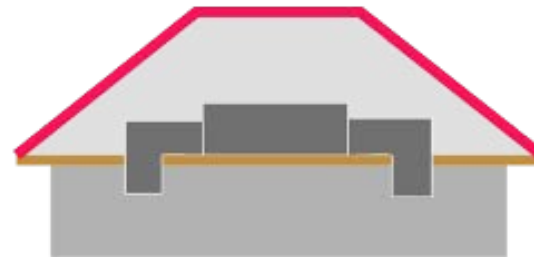
Ducts in Modified Attic Truss



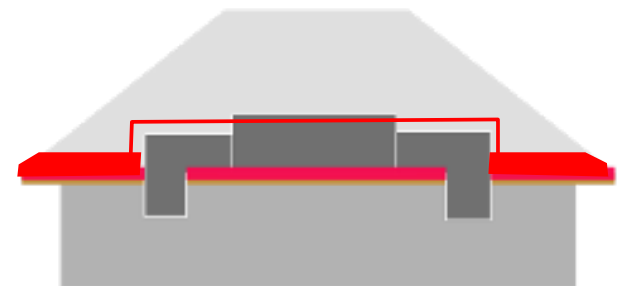
Ducts Between Floors



Ducts in Unvented  
Crawl Space/Basement

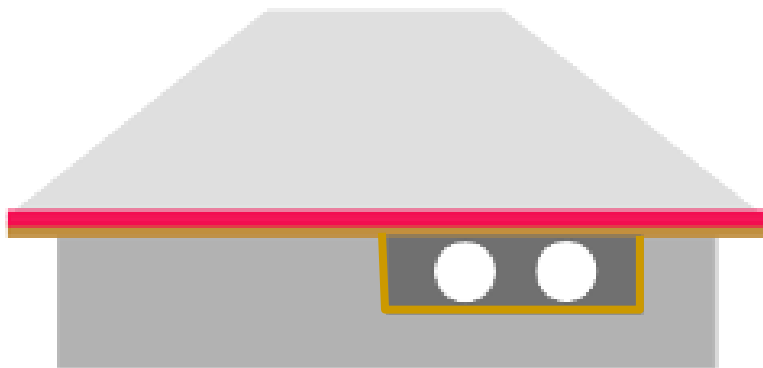


Ducts in Unvented Attic



Ducts in Vented Attic

# Ducts in Conditioned Floor Space Option 1: Dropped Ceiling



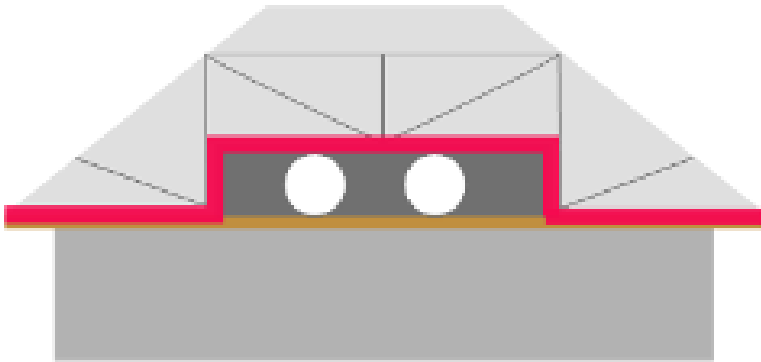
Ducts in dropped ceiling

## Issues:

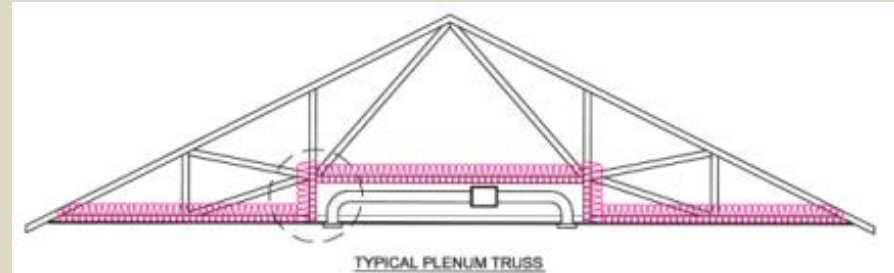
- Architectural Integration
- Good Fit w/Simple Plans
- Longer Throws (ACCA Man T)



# Ducts in Conditioned Floor Space Option 2: Modified Attic Truss



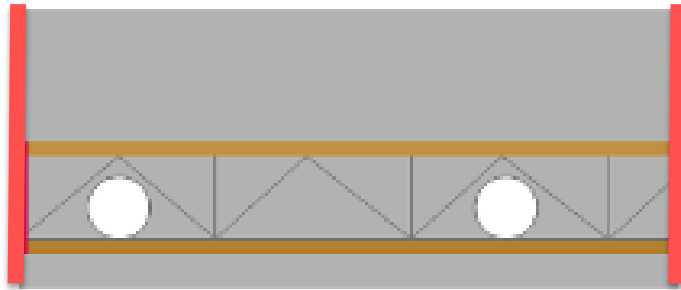
Ducts in modified truss  
in attic



## Issues:

- Design Integration
- Good Fit w/Narrow Plans
- Sealed Air Barrier Critical

# Ducts in Conditioned Floor Space Option 3: Ducts Between Floors



Ducts between floors

## Issues:

- Simple Installation
- Design Flexibility
- Cost-Effective
- Floor Registers Likely





# Ducts in Conditioned Floor Space Option 3: Ducts Between Floors

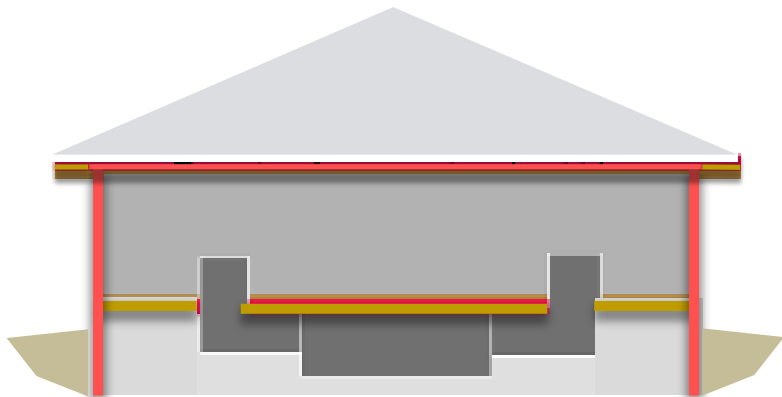
U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





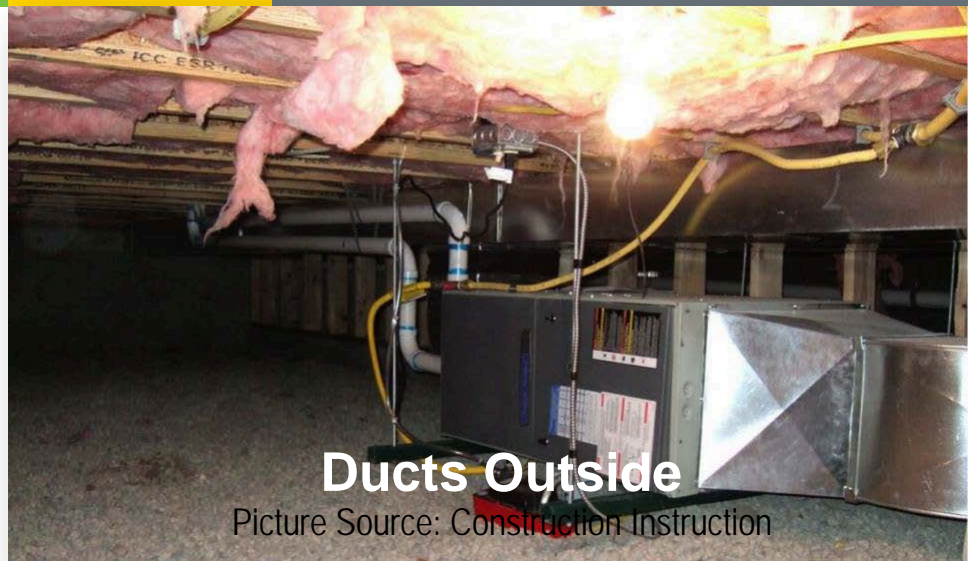
# Unvented Crawl Space/Basement



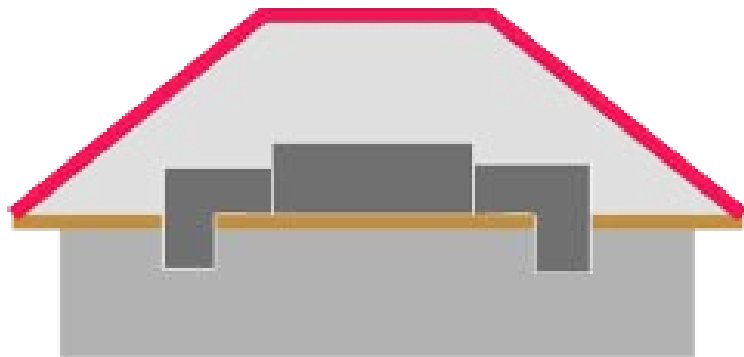
Ducts in unvented crawl space  
or basement

## Issues:

- Simple Installation
- Design Flexibility
- Cost-Effective
- Floor Registers Likely



# Ducts in Unvented Attic



Ducts in unvented attic

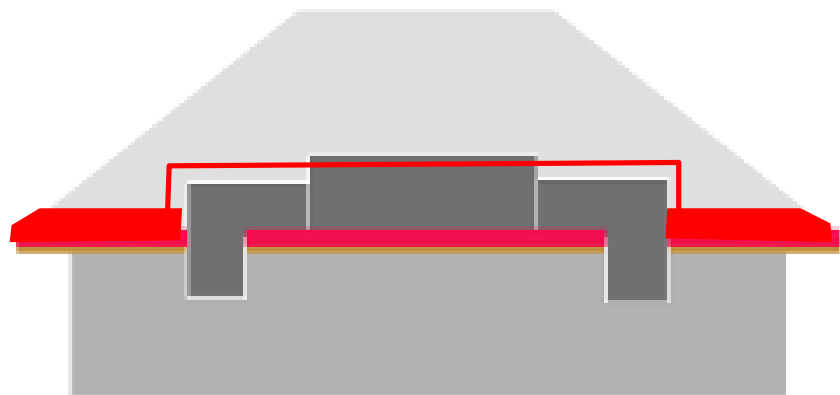
## Issues:

- CZ 5+, air impermeable plus a Class II VR or Class III VR in direct contact
- No Class I VR on attic floor



- **Enhanced Performance:**
  - Ducts and air handler in conditioned space
  - Enable fire sprinklers that don't undermine the thermal and air control layer
- **Cost Savings:**
  - Eliminate ~dozen thermal bypass air barrier details
  - Additional storage, especially in slab-on-grade homes
  - Eliminate need for soffit and roof vents
  - Enabling single- rather than dual-zone HVAC systems by eliminating the egregious attic interface

# Ducts in Vented Attic: Dry CZs



Ducts in vented attic

## Issues:

- R-8 duct insulation min.
- Ductwork buried min. 3.5" blown-in insulation
- Total duct leakage  $\leq 3$  CFM25 per 100 ft<sup>2</sup> CFA
- Air Handler must be inside conditioned space

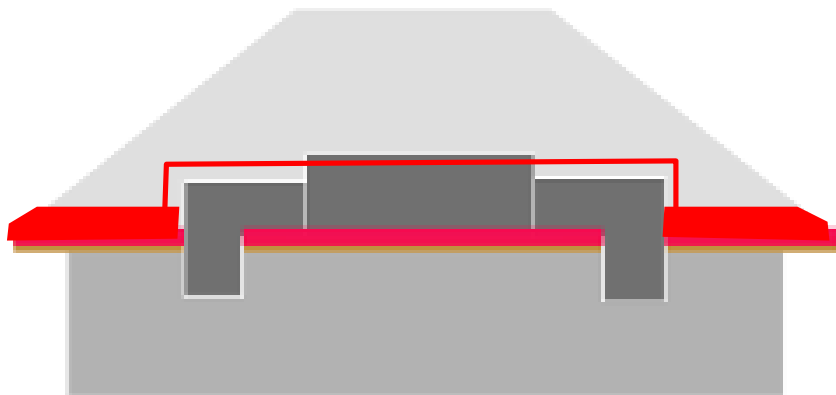


## Buried Ducts (~R-21)

Blown-in  
Insulation

R-8  
Duct

Truss Lower Chord



Ducts in vented attic

## Issues:

- R-8 duct insulation min.
- 1.5" minimum of ccSPF encapsulating ducts
- Ductwork buried min. 2" blown-in insulation
- Total duct leakage  $\leq 3$  CFM25 per 100 ft<sup>2</sup> CFA
- Air Handler must be inside conditioned space



## Buried Encapsulated Ducts (BEDs) (~R-25)

Blown-in  
Insulation

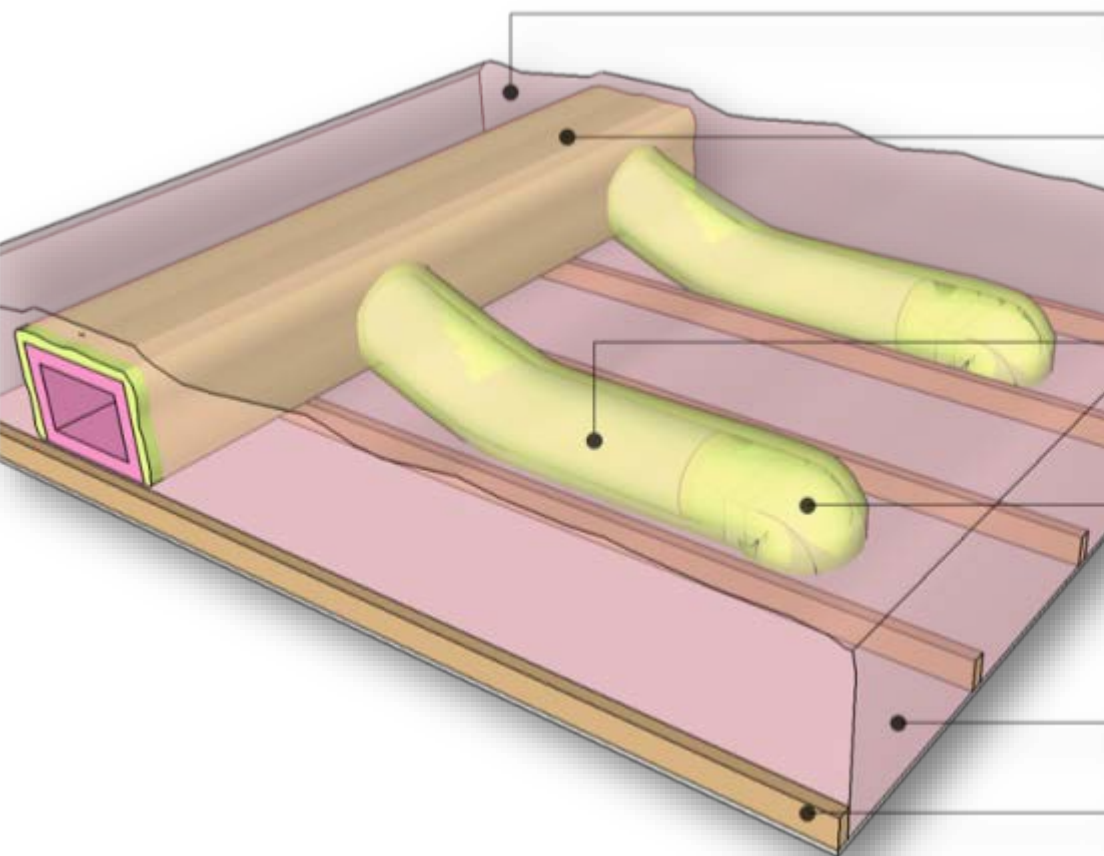
Closed-Cell  
Foam

R-8  
Duct

Truss Lower Chord



# Buried Encapsulated Duct (BED)



Ducts buried under  
loose-fill insulation

R-8 ducts encapsulated  
in 1.5" ccSPF

R-8 flex duct encapsulated  
in 1.5" ccSPF

Duct boot connection  
encapsulated in 1.5" ccSPF

Drywall ceiling

Truss lower chords





Zero Energy Ready Home Training

Zero Specifications

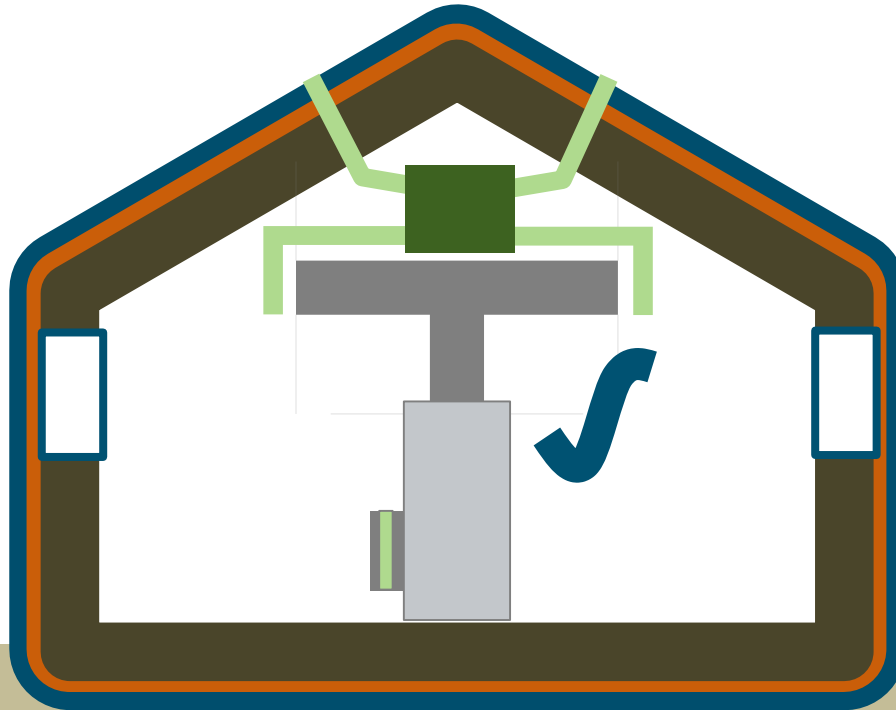
**Indoor Air Quality**

# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

Indoor Air  
Quality



+



- Radon Resistant
- Low Emission Materials
- Combustion Safety
- High MERV Filter

=



# Why IAQ is NOT A La Carte?

- 2000 SF Home
- 8.5' Ceilings
- 3 ACH50 Air Tightness
- 200 cfm Exhaust  
(e.g. dryer, range hood)

**- 5 Pa depressurization**



- Source Control



## Practices & Product Selection That Limit:

- Moisture
- Radon
- Chemicals
- Combustion By-Products
- Biological Contaminants

- Dilution



- Filtration

## HVAC Quality Installation System

# Source Control: Moisture Moisture Control System

- **Moisture Vapor:**

- Air Sealing
- Air Barriers
- Vapor Barriers/Retarders

**Thermal  
Enclosure  
System**

- **Bulk Moisture:**

- Water-Managed Roofs
- Water-Managed Walls/Opening
- Water Manage Foundation/Site
- Water Managed Materials

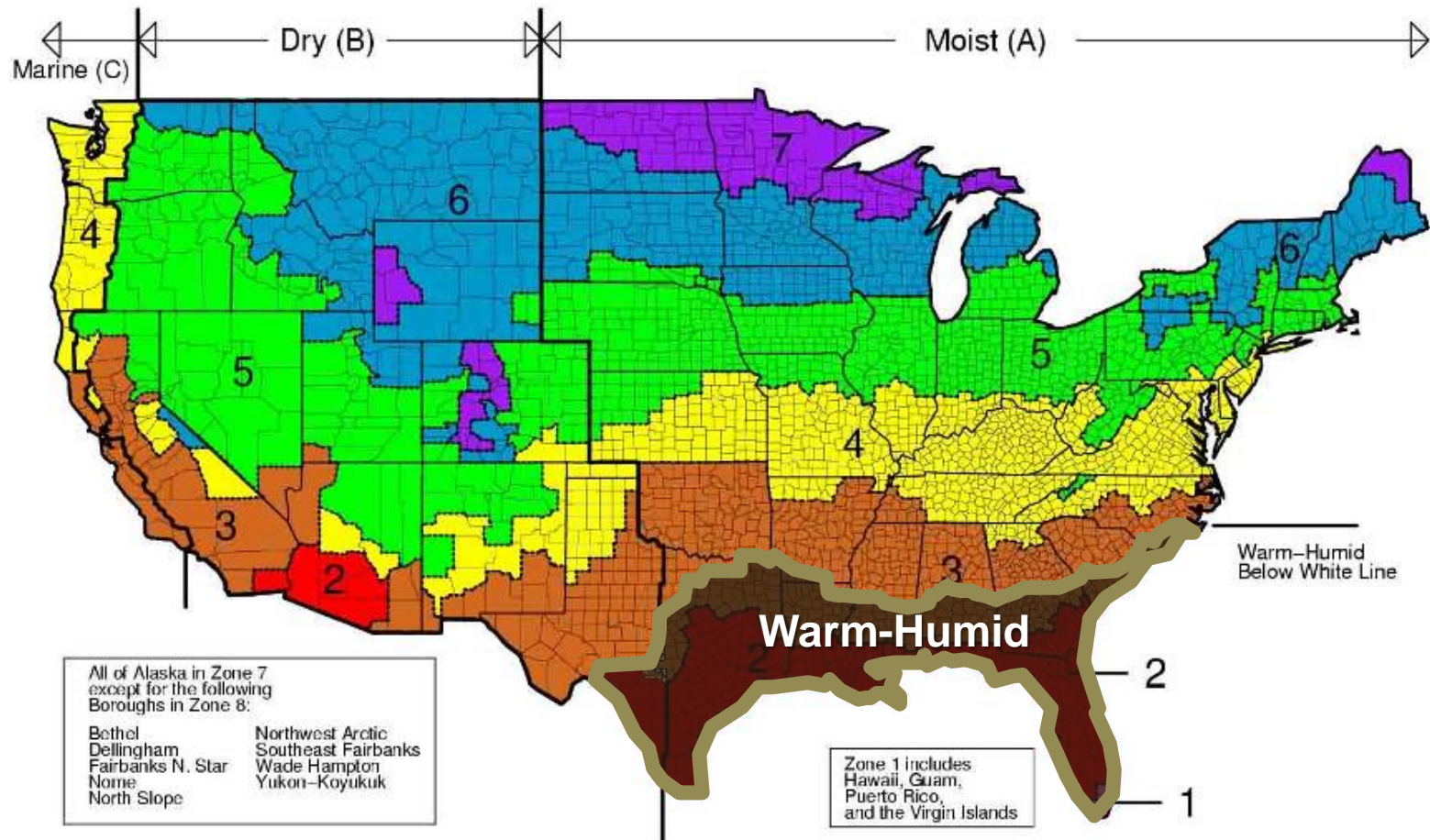
**Water  
Managed  
Construction**

- **Internal Moisture Control:**

- HVAC Quality Installation
- Whole-House Ventilation
- Sport Ventilation
- Dehumidification [Warm-Humid Climates]

**HVAC System**

# Source Control: Moisture Dehumidification in Warm-Humid CZs





Equipment with sufficient latent capacity to maintain indoor relative humidity (RH)  $\leq$  60%:

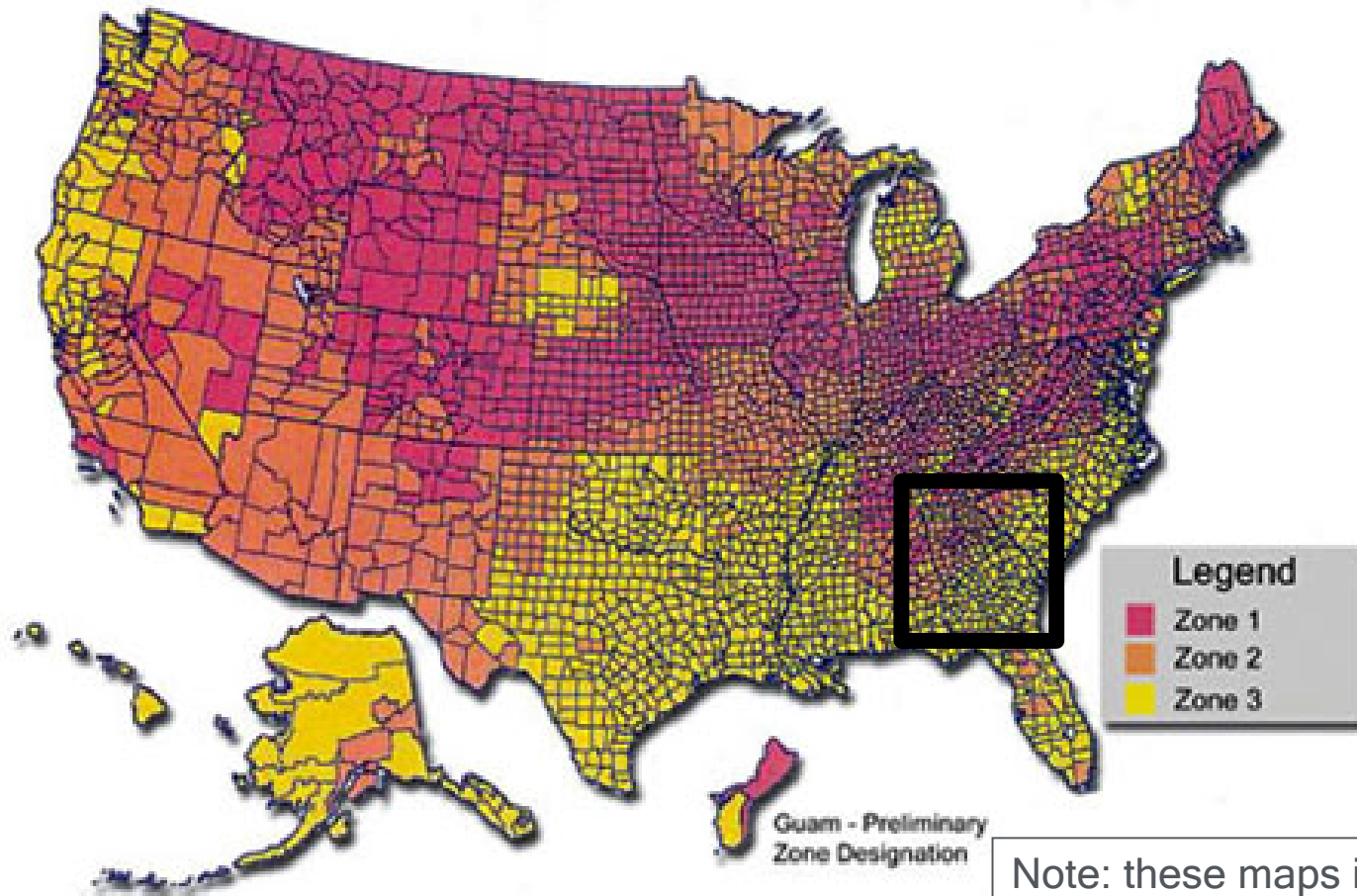
- Additional dehumidification system(s), OR
- A central HVAC system equipped with additional controls to operate in dehumidification mode.

Dust mites in the billions  
at 60% RH or higher



# Source Control: Radon Radon Zones in U.S.

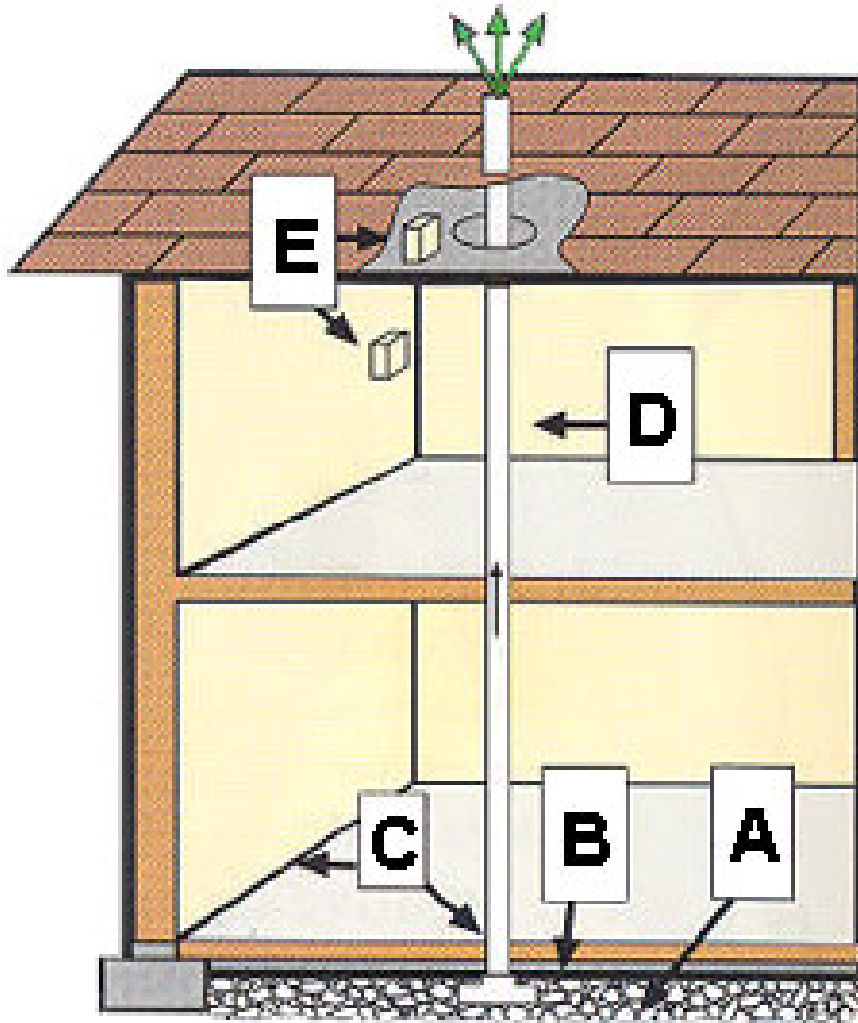
EPA Map of Radon Zones



**Surgeon General's Warning:  
Radon Causes Lung Cancer**

Note: these maps indicate average risk by county. However, High levels of Radon can be found in any home.

# Source Control: Radon Radon Resistant Construction



## Required for Moisture Control:

- A. Gas Permeable Layer  
(min. 4" clean gravel)
- B. Plastic Sheetting  
(under slab)
- C. Sealing and Caulking  
(all openings in concrete floor)
- D. Vent Pipe  
(3 or 4 inch PVC pipe)
- E. Junction Box  
(if fan needed later)

**Radon Test Kits Not Required**

# Source Control: Biological Contaminants

## Pests





Corrosion-proof rodent/bird screens for openings  
(e.g., copper or stainless steel mesh)

**Exception:** clothes dryer vent



Sealed Sump Pump



Air Sealing



# Source Control: Combustion By-Products Power/Direct Vent Equipment

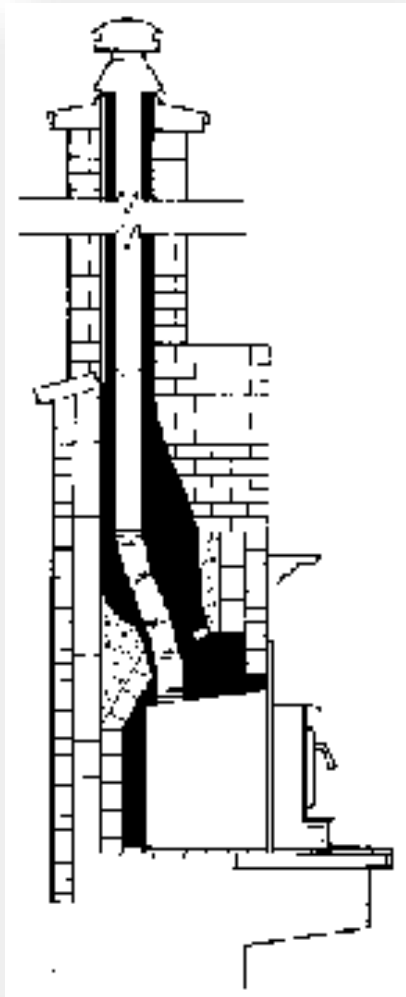


Power Vented Water Heater



Direct-Vent Furnace

# Source Control: Combustion By-Products Certified Fireplaces & Stoves



- Vented to outdoors
- Adequate Combustion and Ventilation Air
- Gas fireplace power or direct vented
- Meet Specified Standards

# Source Control: Combustion By-Products Certified CO Alarms

CO Alarm in each bedroom area



CO Alarm



Combined CO  
& Smoke Alarm



Enforceable policy in  
Multi-family buildings



# Source Control: Combustion By-Products Attached Garage Isolation



## Air Sealing & Gasketed Door

## Exhaust Fan Optional





## No Air Handler in the Garage

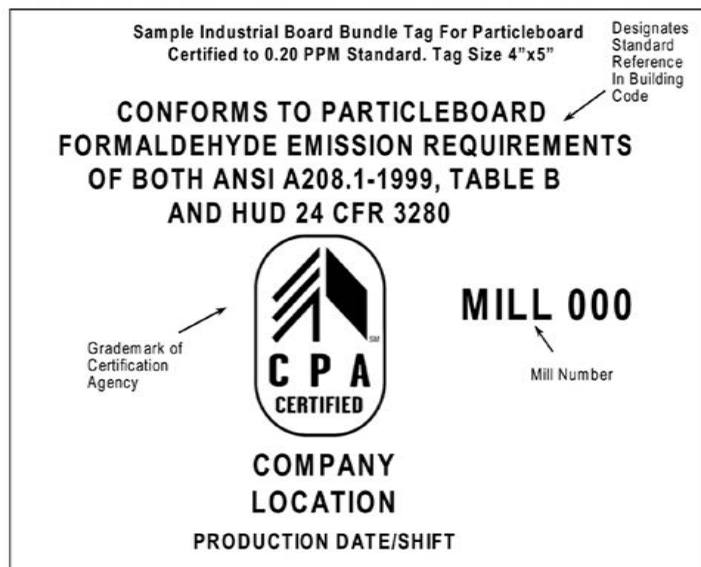


Picture Source: Construction Instruction

# Source Control: Chemicals

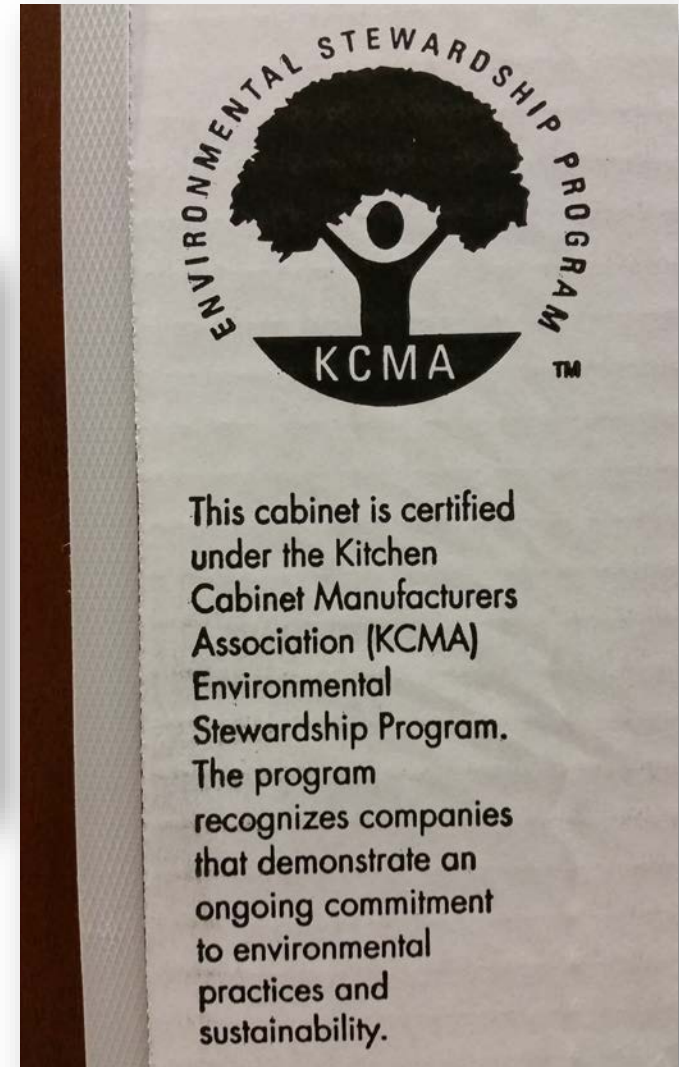
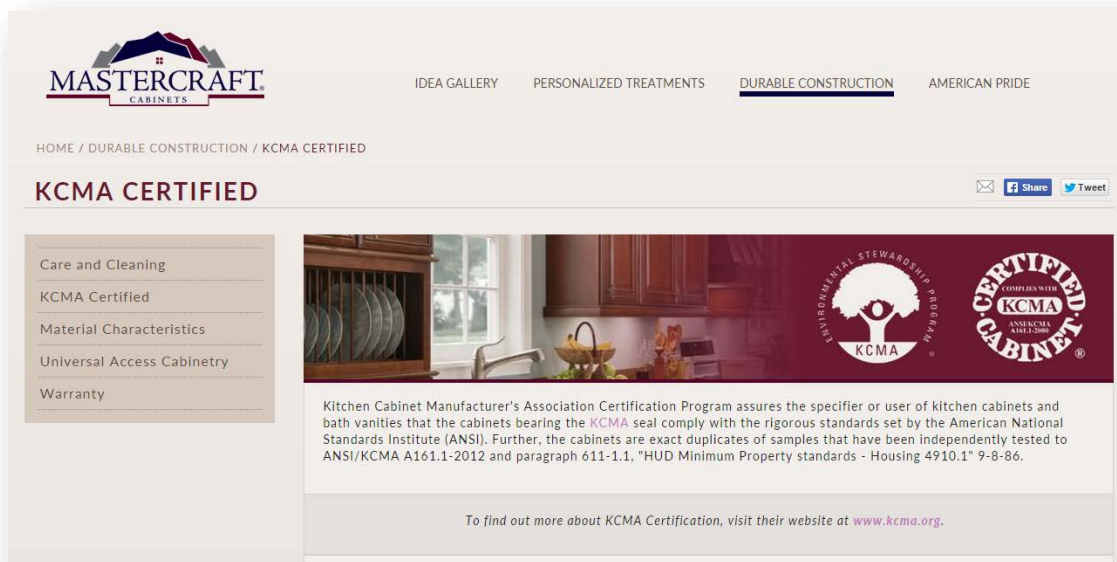
## Low Formaldehyde Pressed Wood

### *MDF & Particleboard*





# Source Control: Chemicals Low Formaldehyde Cabinets



- Visit [www.kcma.org](http://www.kcma.org)
- Follow Industry Professional link to Environmental Stewardship Program

## Health Hazards of VOCs

VOLATILE Organic Compounds

### Immediate

- Eye & Respiratory Tract Irritation
- Headaches
- Dizziness
- Visual Disorders
- Memory Impairment

### Up to 6 years

- Eye, Nose, and Throat Irritation
- Headaches
- Loss of Coordination
- Nausea
- Damage to Liver, Kidney, and Central Nervous System
- Cancer





Carpets and carpet adhesives shall be labeled with, or ***otherwise documented as meeting, the Carpet & Rug Institute (CRI) Green Label Plus or Green Label testing program criteria.*** Carpet cushion (i.e., padding) shall similarly be certified to meet the CRI Green Label testing program criteria.



# Source Control: Chemicals

## Identifying Low-Emission Solutions

- Low emission materials and products are rapidly evolving, gaining market share & recognition
- Standards, labels, certification agencies can be challenging to navigate
- To help partners identify sources and spec products, a new IAP resources is available:

### How to Find Indoor airPLUS Compliant Low-Emission Products



#### How to Find Indoor airPLUS Compliant Low-Emission Products

##### Cabinetry

**Requirement:** Use Cabinetry made with component materials (plywood, particleboard, MDF) that are certified to comply with the appropriate standards above; **OR** registered brands or products produced in plants certified under the Kitchen Cabinet Manufacturers Association's (KCMA) Environmental Stewardship Certification Program (ESP 05-12); **OR** GREENGUARD or GREENGUARD Gold Certification for Cabinetry.



Meet at least one standard below

How to find compliant products

*KCMA's Environmental Stewardship Program (ESP 05-12)*

Look for the KCMA-ESP label on cabinets (often sink bases), product packaging, and/or spec sheets.

For a list of KCMA certified manufacturers that produce compliant cabinets, visit:  
[http://www.kcma.org/Members/ESP\\_Certified\\_Manufacturers](http://www.kcma.org/Members/ESP_Certified_Manufacturers)

*Note: Manufacturers listed in the link above can be used as a resource, but partners should request confirmation from the manufacturer or supplier that the product lines they are using are indeed compliant.*





## Three Options:

- Exhaust-Only
- Supply-Only
- Balanced

## ASHRAE 62.2 2010 Continuous Ventilation Rate:

$[7.5 \text{ cfm} * (\# \text{ bedrooms} + 1)] + [.01 * \text{Sq. Ft.}]$

2,000 sq. ft., 3 Bedroom Home Example:

$[7.5 * (3+1)] + [.01 * 2,000] = [30 + 20] = 50 \text{ cfm}$



- WHMV Fan Efficiency

- For an example home of 4 BR and 2500 SF in CZ5:

- $Q_{fan} = 0.01 * A_{floor} + 7.5(N_{br} + 1)$
- $= 0.01 * (2500) + 7.5 * (5) = 63 \text{ cfm}$

CZ 1-2	CZ 3, 4 (except Marine)	CZ 4 Marine, 5-8
2.8 cfm/W	2.8 cfm/W	1.2 cfm/W
No heat exchange	No heat exchange	HX with 60% SRE

- $63 \text{ cfm} / (1.2 \text{ cfm/W}) = 53 \text{ Watts BALANCED w/ 60\% SRE}$

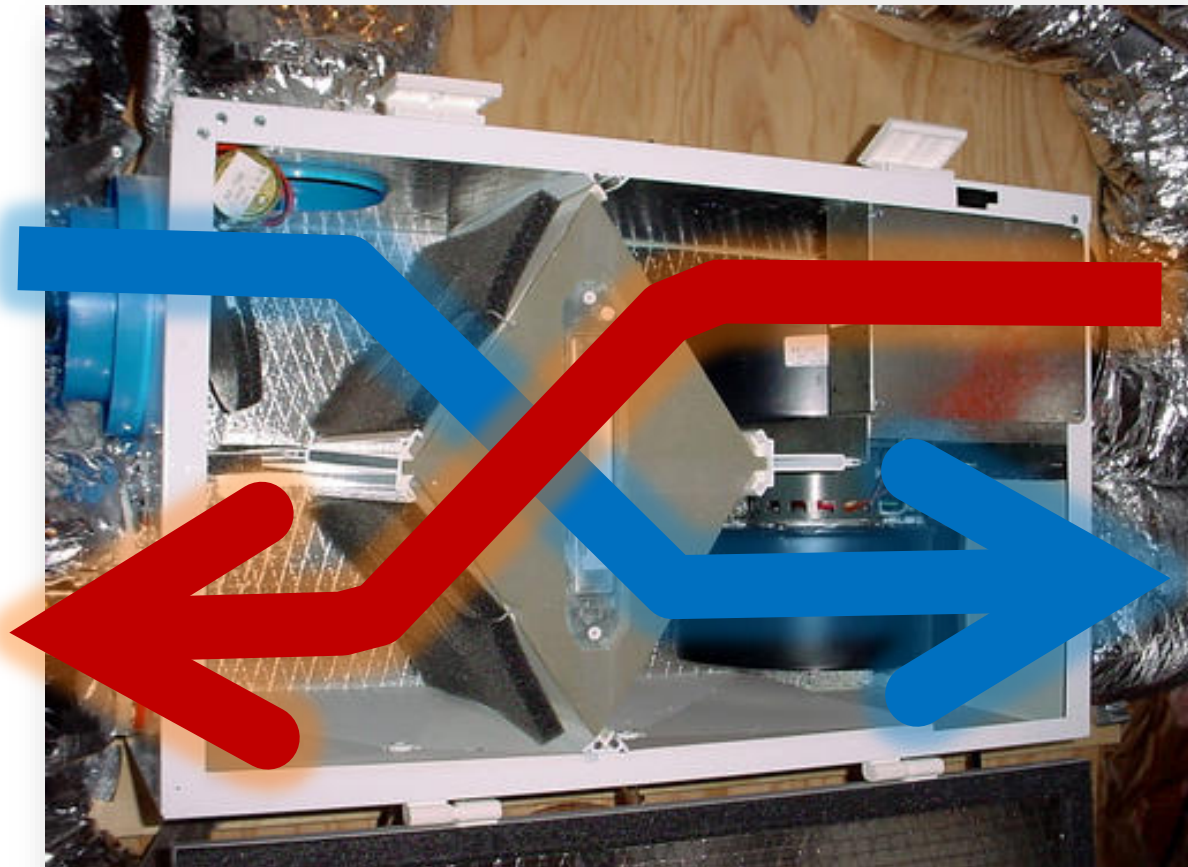
# Dilution: Whole-House Ventilation Exhaust-Only Ventilation



# Dilution: Whole-House Ventilation Supply-Only Ventilation



# Dilution: Whole-House Ventilation Balanced Ventilation



ERV or HRV

# Dilution: Whole-House Ventilation Low-Cost Balanced Ventilation





## Simple Thru-Wall ERV

- 90+% Heat Recovery
- 20-30% Humidity Recovery
- 1.4 – 2.8 W for 10/18/22 CFM





# Dilution: Whole-House Ventilation Ventilation Challenge: Persistence

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Dilution: Spot Ventilation

- Kitchen:
  - 100 CFM Intermittent
  - 5 ACH Continuous
- Bathrooms:
  - 50 CFM Intermittent
  - 20 CFM Continuous



# Filtration: High-MERV HVAC Filter



8 MERV Filter Minimum

- 1-page checklist
- Builder or Rater may verify
- Permissible methods:
  - Visual verification on site during construction
  - Reviewing photos taken during construction
  - Checking documentation
  - Equivalent methods as appropriate
- Sampling permitted per RESNET protocol



Zero Energy Ready Home Training

Zero Specifications

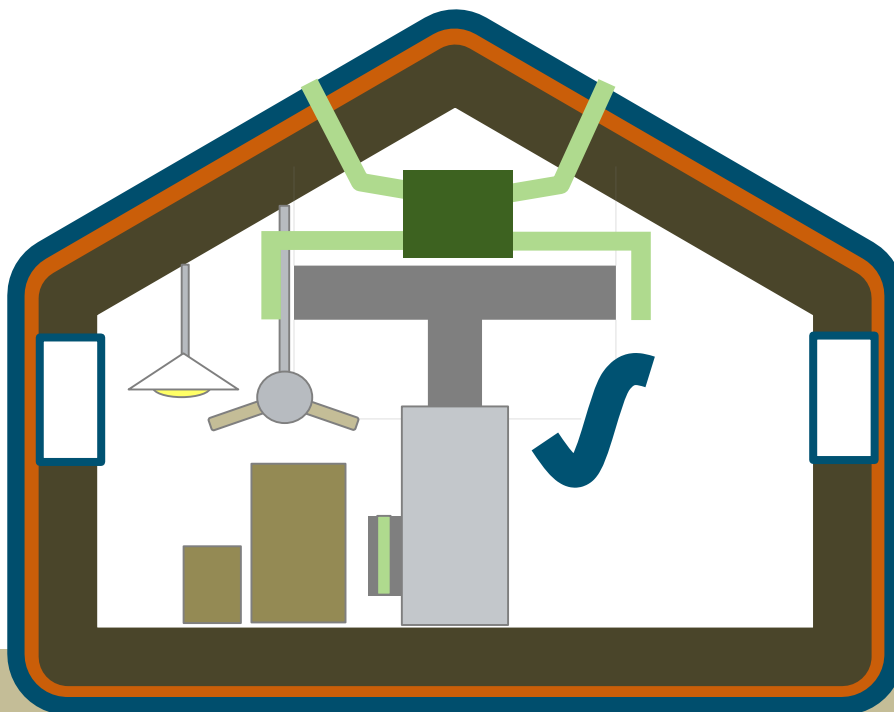
# Efficient Components

# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

Efficient  
Comps



\* Target only



+

## ENERGY STAR:

- Appliances
- Exhaust Fans
- Ceiling Fans
- Water Heating\*

+

## Efficient:

- Lighting
- Hot Water Distribution
- Equipment\*

=





**Components and MEL's** are increasingly larger part of total energy use in low-Load homes (~50%).

Zero Energy Ready Home requires:

- **ENERGY STAR Certified Appliances:\***  
refrigerators, dishwashers, clothes washers
- **ENERGY STAR Certified Fans\*:**  
bathroom ventilation, ceiling fans
- **ENERGY STAR Certified Lighting:**  
Min. 80% of fixtures or lamps (CFL or LED)
- **WaterSense Hot Water Distribution**

\*Only where installed by builder

Zero Energy Ready Home Target Home also specifies **ENERGY STAR Water Heating:**

Water Heater Type	Target Home Water Heater's Energy Factor
Gas/Propane $\leq$ 55 gallons	EF = 0.67
Gas/Propane $>$ 55 gallons	EF = 0.77
Electric Systems	EF = 2.0
Heating Oil	EF = 0.60

Zero Energy Ready Home Target Home also specifies **High-Efficiency Space Conditioning:**

HVAC Equipment	Target Home Efficiency		
	Hot Climates (IECC Zones 1,2)	Mixed Climates (IECC Zones 3, 4 except Marine)	Cold Climates (IECC Zones 4 Marine, 5, 6, 7, 8)
AFUE	80%	90%	94%
SEER	18	15	13
HPSF	8.2	9	10
Geo Heat Pump	ENERGY STAR EER/COP		

- **Indoor Fixtures**
  - Plumbing Fixtures
  - Appliances and Other Equipment
- **Distribution**
  - Service Pressure
  - Metering (for Multi-Family Homes)
  - Leak Prevention
  - **Hot Water Distribution**
- **Outdoor**
  - Landscape Design
  - Irrigation (if installed)



- “Must Have” for zero net-energy ready homes
- Based on EPA WaterSense Specifications:
  - No more than 0.5 gallons of water in any piping/manifold between the hot water source and any hot water fixture.
  - No more than 0.6 gallons of water shall be collected from the hot water fixture before hot water delivered.
  - Timer- and temperature-based recirculating systems shall not be used to meet the criteria.



Built for when water was free and energy was cheap!

Copper L piping:

- 1" = 5.53 ounces/ft
- $\frac{3}{4}$ " = 3.22 ounces/ft
- $\frac{1}{2}$ " = 1.55 ounces/ft

Storage Volume:

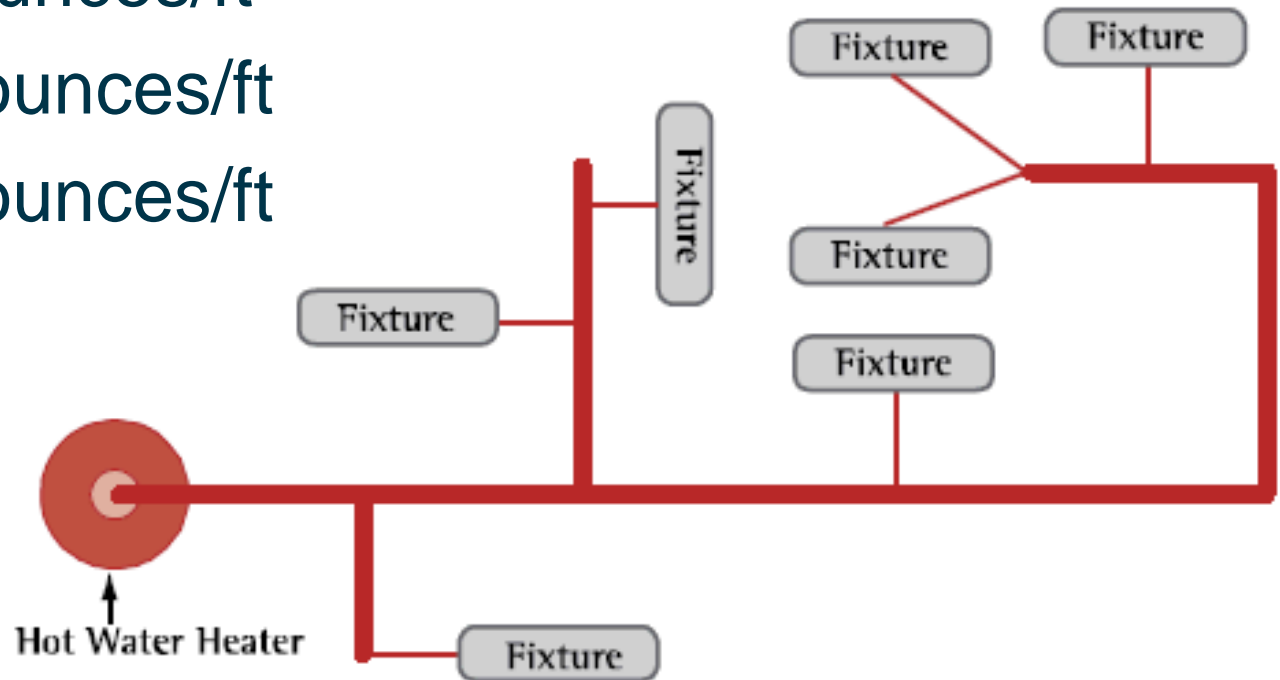
306 gallons

10' branch

Wait Time: 1 – 1.5

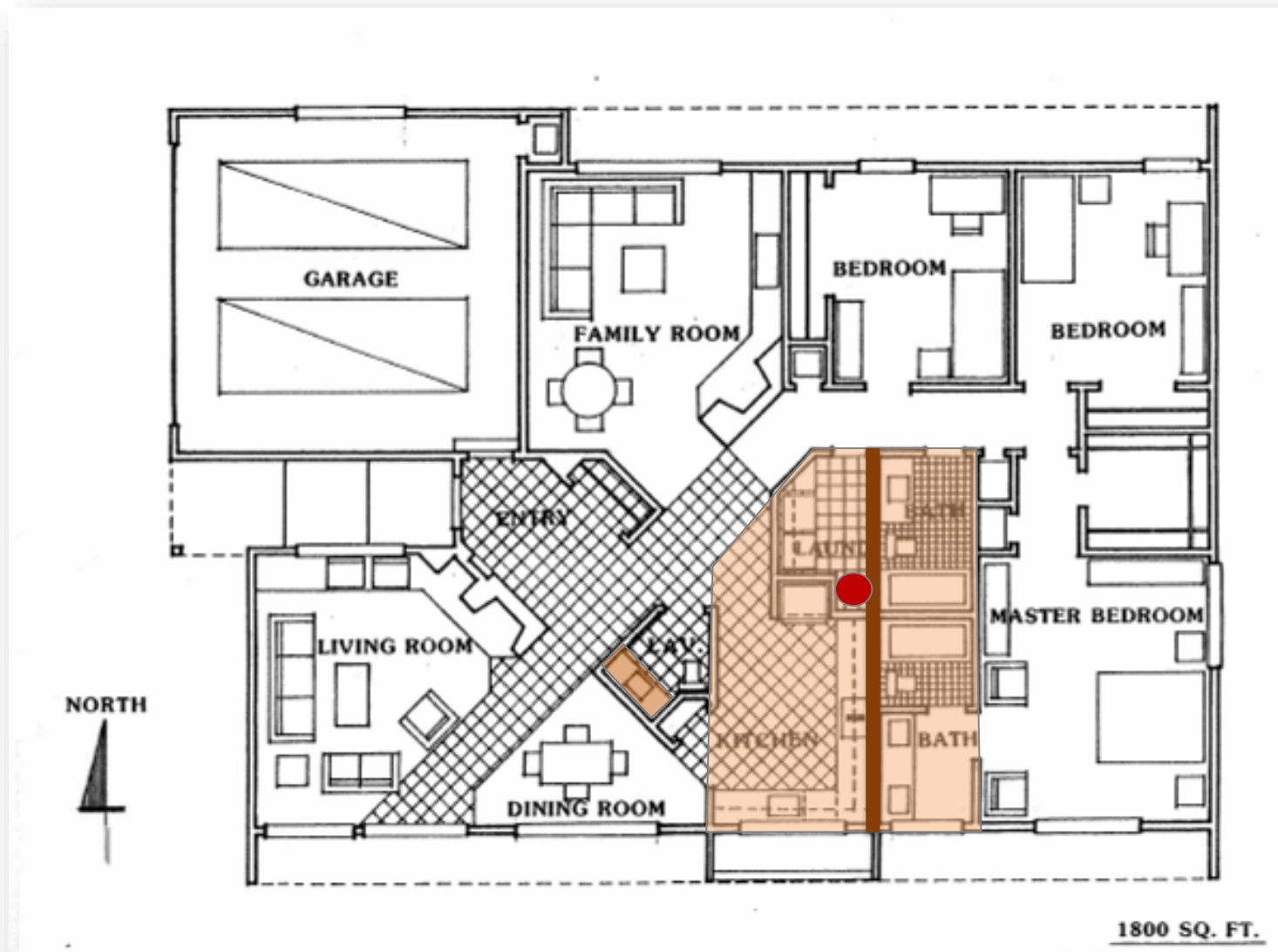
minutes

2 GPM Showerhead



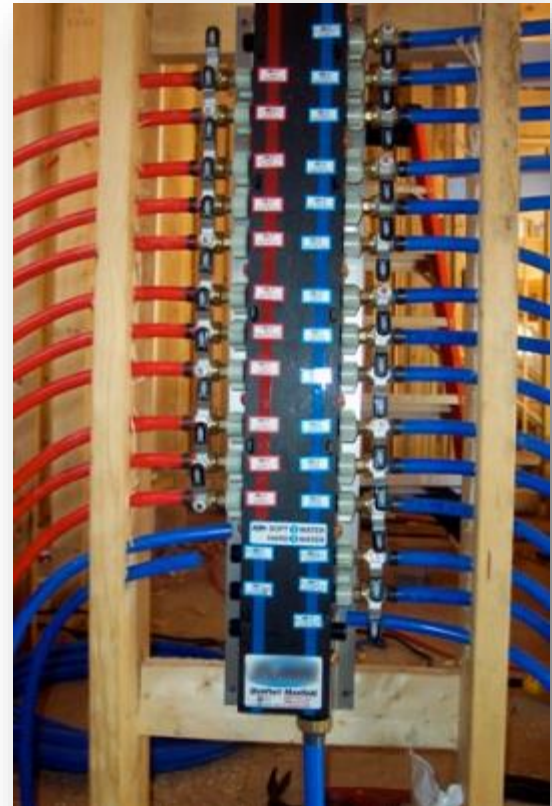
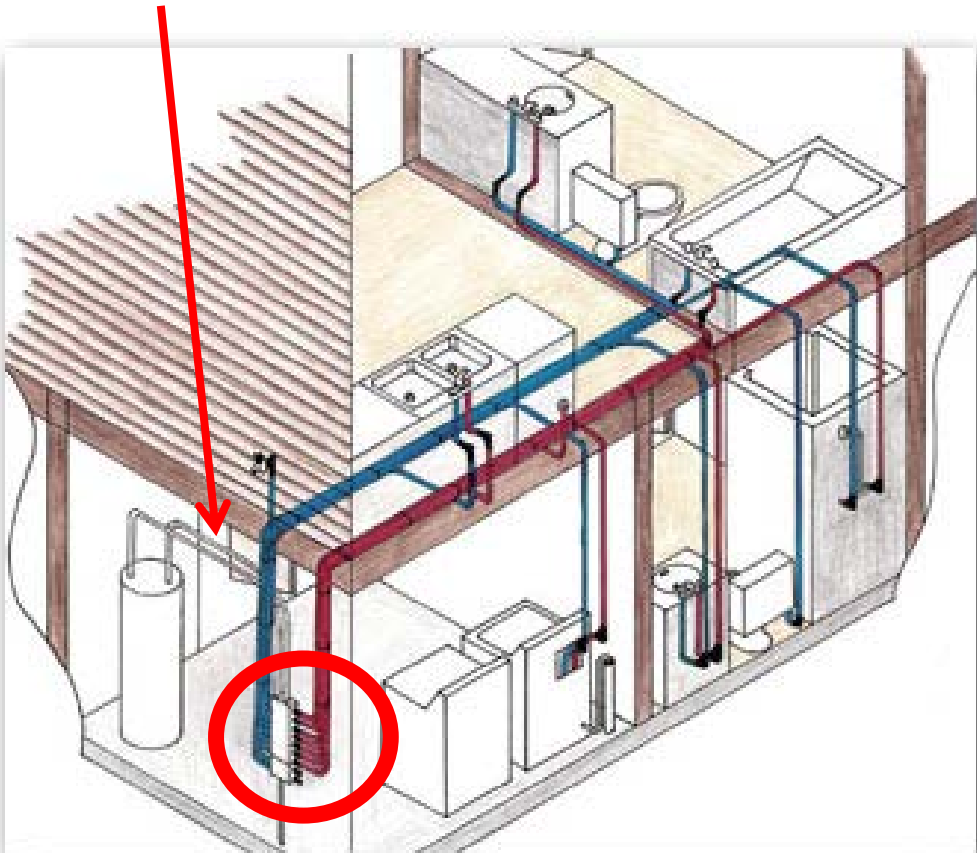
- Core Plumbing Layout (wet wall)
- Manifold System
- Demand Pumping System

# Core Plumbing Layout

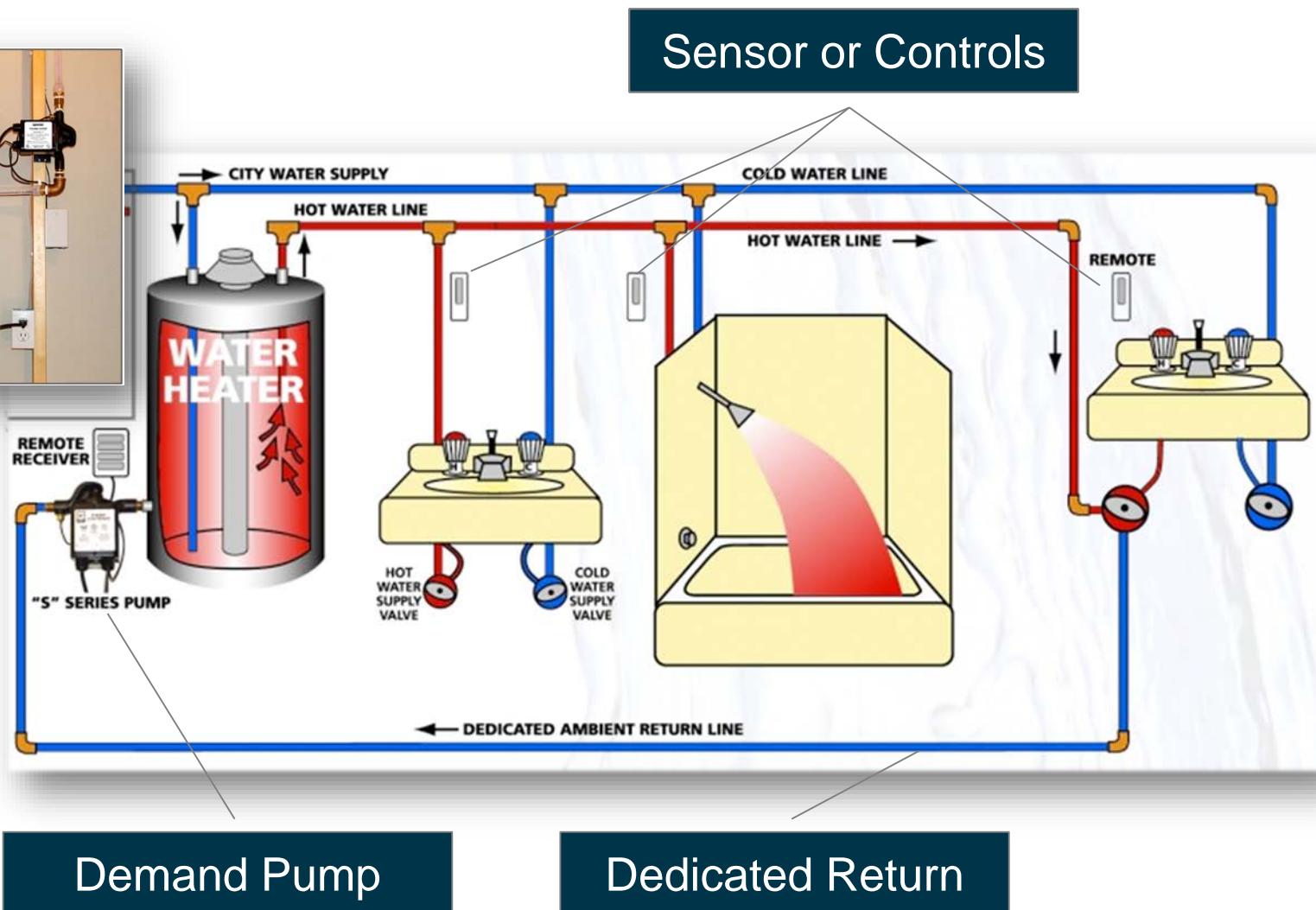


# Manifold Plumbing System

10' Max



# Demand Pumping System



## 1. Initiate Operation:

Turn on any occupant-controlled or occupancy sensor-based recirculation systems, if present.

## 2. Container Placement:

Locate bucket or flow measuring bag pre-marked for 0.6 gallons under the hot water fixture. Only need to test fixture with greatest stored volume of hot water.

## 3. Turn on Hot Water Over Digital Thermometer:

Record starting temperature.

## 4. Final Measurement:

When water reaches 0.6 gallons in container, record temperature again. A minimum increase of 10° F is required to pass the test.





Zero Energy Ready Home Training

Zero Specifications

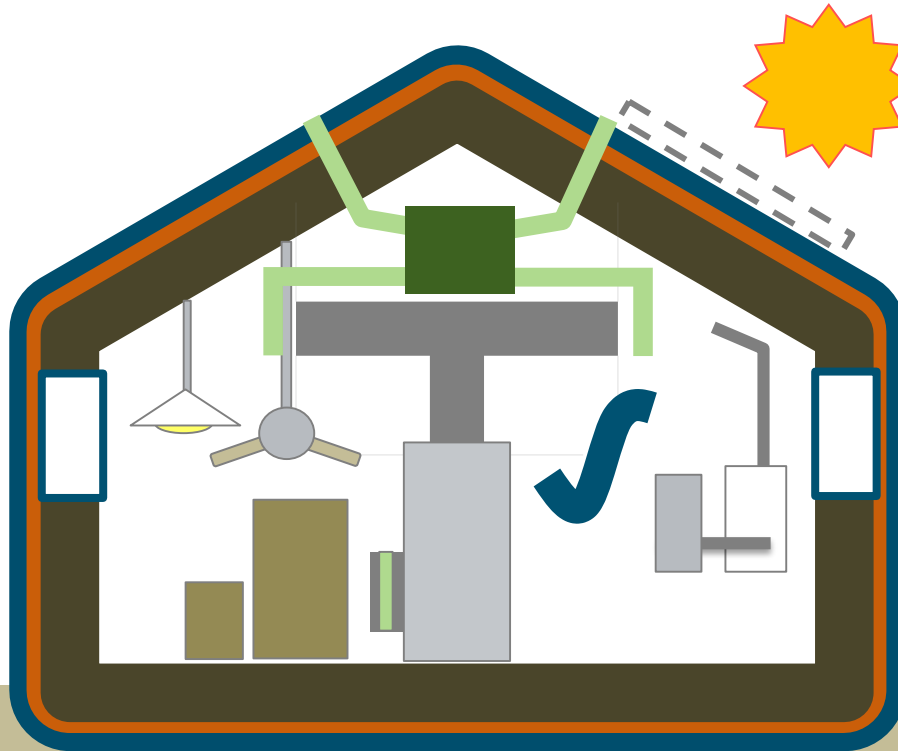
# Solar Ready Construction

# Zero Energy Ready Home Spec

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

Solar  
Ready



+

DOE ZERH  
PV-Ready Checklist

=

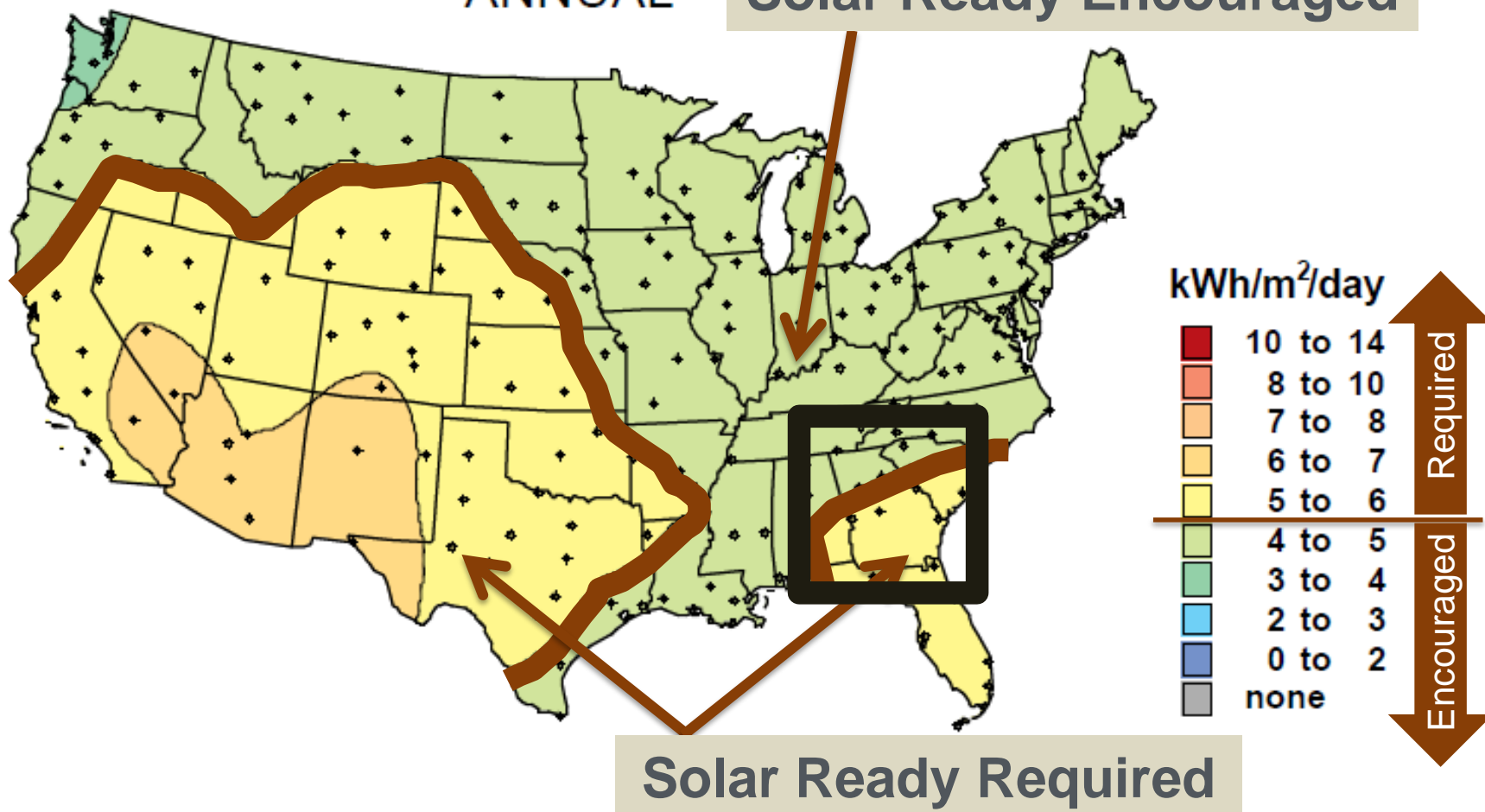


# Solar Ready Applicability

Average Daily Solar Radiation Per Month

ANNUAL

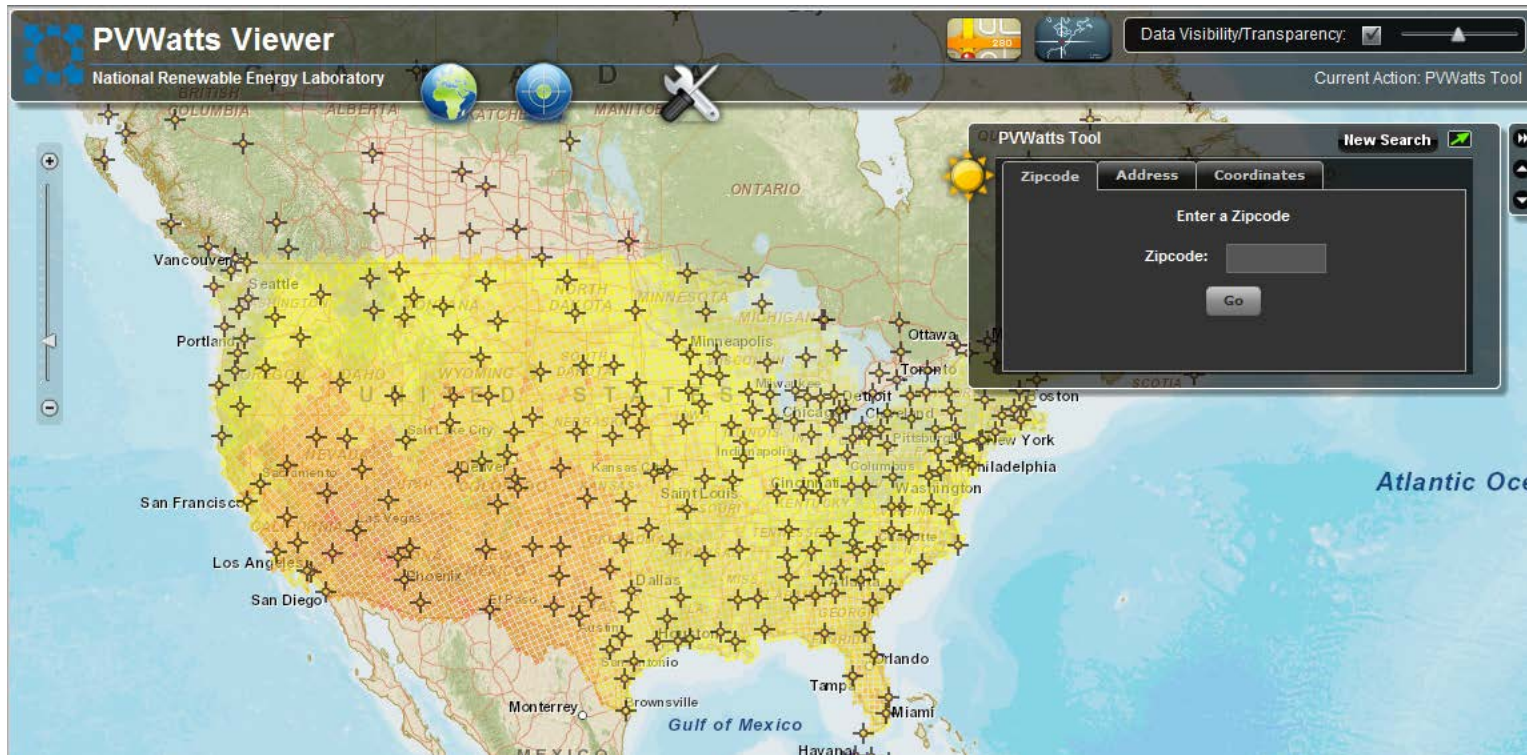
Solar Ready Encouraged



Solar Ready Required

- **Renewable Energy Ready Checklists**

- Determine applicability by zip code
- [http://gisatnrel.nrel.gov/PVWatts\\_Viewer/index.html](http://gisatnrel.nrel.gov/PVWatts_Viewer/index.html)
- In this Mid-Atlantic example, solar resources = 4.8 kWh/m<sup>2</sup>/day



Not required in areas lacking access to significant solar resources:

- Tree Shading
- Tall Buildings
- Available South Facing Roof



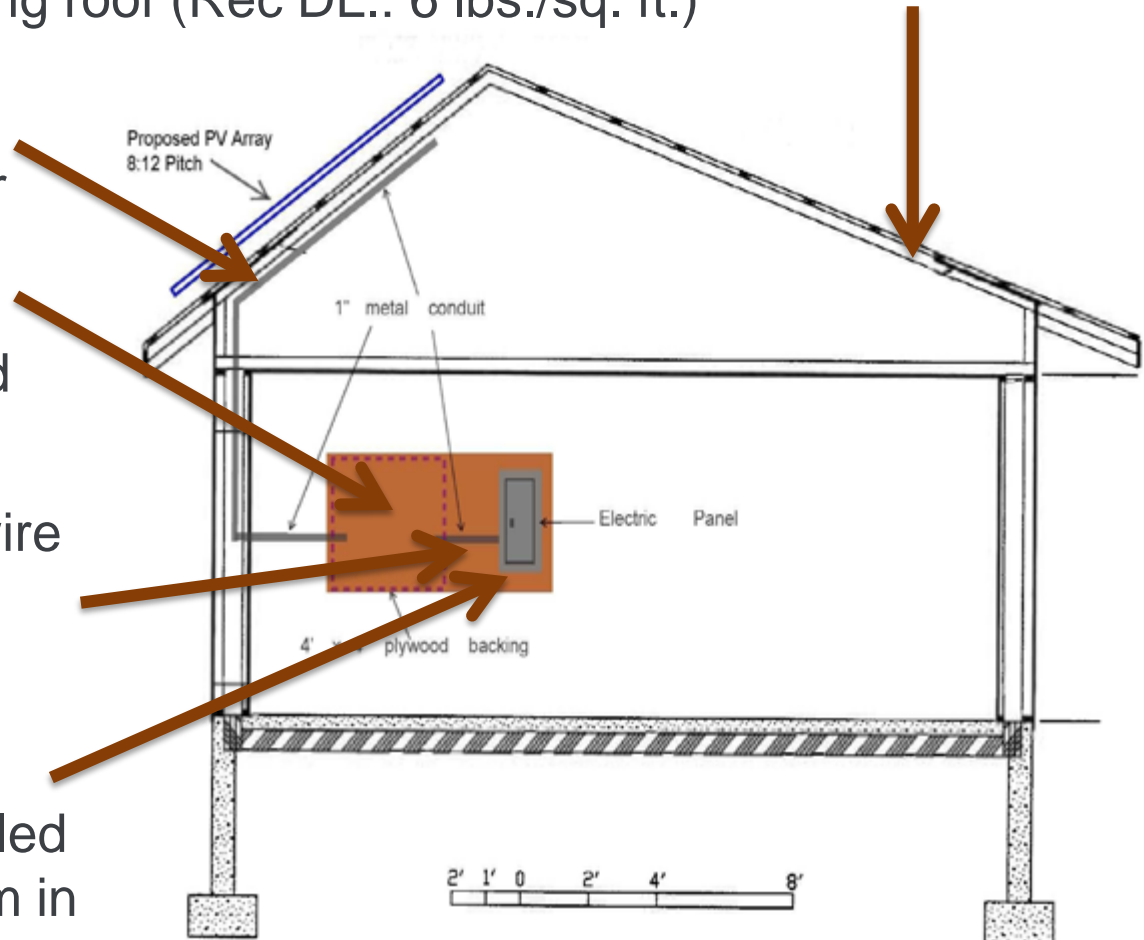
**Documentation** of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: 6 lbs./sq. ft.)

**Conduit** to run DC wire from roof to inverter

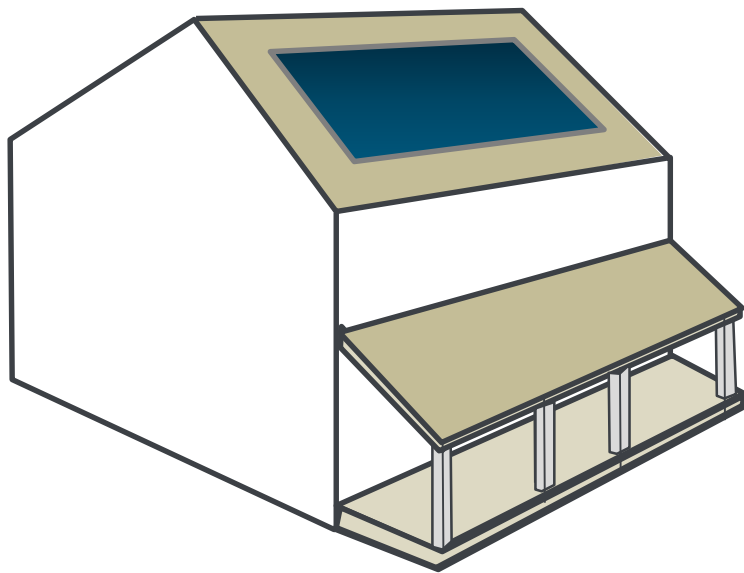
**Dedicated Area** for installing inverter and balance of system

**Conduit** to run AC wire from inverter location to electric panel

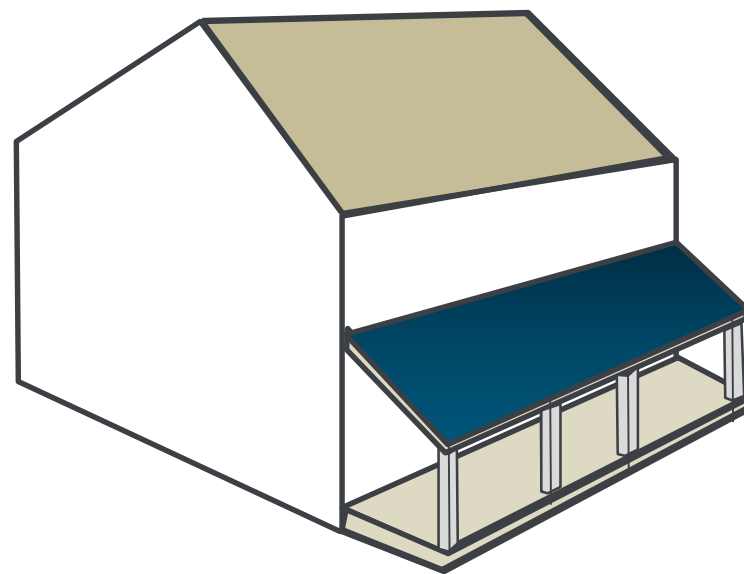
**Circuit Breaker** designated and/or installed for use by the PV system in the electric panel







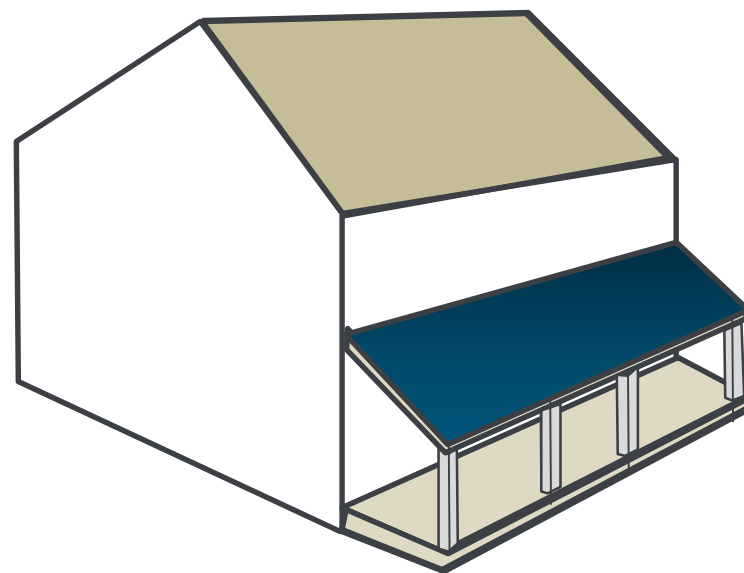
PV Mounted on Roof



PV Integrated into  
Front or Rear Porch Roof  
Directly on Porch Framing

## Benefits:

- Cost
- Appearance
- Maintenance
- Daylighting



PV Integrated into  
Front or Rear Porch Roof  
Directly on Porch Framing

# Integrated Renewable Energy

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Integrated Renewable Energy

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy





# Integrated Renewable Energy

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



smartflower™ POP, made in Austria



- RERH checklist for DOE ZERH Home
  - builder or rater may verify



# Zero Energy Ready Home Training

## Zero Specifications

# Summary

# Stepping up to ZERH Summary...

				Solar Ready	Solar Ready
				Eff. Comps.& H <sub>2</sub> O Distrib.	Eff. Comps.& H <sub>2</sub> O Distrib.
				EPA Indoor Air Package	EPA Indoor Air Package
				Ducts in Condit. Space	Ducts in Condit. Space
		HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HVAC QI + HRV
		Water Management	Water Management	Water Management	Water Management
		Independent Verification	Independent Verification	Independent Verification	Independent Verification
IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2012/15 Encl./ES Win.	Ultra-Efficient Enclosure
HERS 85-90	HERS 70-80	HERS 65-75	HERS 55-65	HERS 48-55	HERS 35-45
<b>IECC 2009</b>	<b>IECC 2012</b>	<b>ENERGY STAR v3</b>	<b>ENERGY STAR v3.1</b>	<b>ZERH</b>	<b>PHIUS+</b>



# Zero Energy Ready Home Training

## **Zero Recognition**

5) **The Washington Post**

Date: Saturday, June 16, 2012  
Location: WASHINGTON, DC  
Circulation (DMA): 311,688 (8)  
Type (Frequency): Newspaper (D)  
Page: E1.E3  
Keyword: KB Home

---

**Model home shows off its green side**

House in Waldorf demonstrates eco-friendly and money-saving features to buyers

BY V. DION HAYNES

"Becoming more environmentally friendly has been the focus of the country," Moran added. "We want to give people a vision of where we think home building will be in a few years."

Thus far, net-zero houses are a very tiny segment — perhaps as small as 1 percent — of the market.

Production of energy from solar panels, one of the largest components of the green-home movement, is growing. The amount of megawatts produced by home solar panels rose 104 percent in 2010, 109 percent in 2011 and is expected to increase 75 percent this year, according to Boston-based GTM Research, a consulting firm that tracks the industry for the

"They didn't have this [model] when we purchased our home" three doors down the street in October, said Nickiea Youmans, who along with her husband, Linzy, walked into the back yard to check out the house. "We would have been very interested in this," she added.

- Branding [Logos, Home Certificates, Labels]
- ‘Tour of Zero’/National Campaign
- Sales Training Webinar
- Customizable Point-of-Sale Fact Sheet
- Customizable Homebuyer Brochures
- Customizable Homeowner Manual
- Building Science Translator Sales Tool (BASC)
- Drop-in DOE Messaging
- Trade-Partner Recognition Form
- Leading Builder Round-Table Meetings



- DOE 'Tour of Zero'
- DOE Housing Innovation Awards
- Press Release Templates for Award Winners
- Web Site Locator Tool
- Home Builder Profiles

Nearly 1 in 3 consumers indicated they  
**do not trust**  
home building and real estate companies.

Source: The business of Trust – The Most Trusted Builders in America,  
Lifestory Research, January 2013

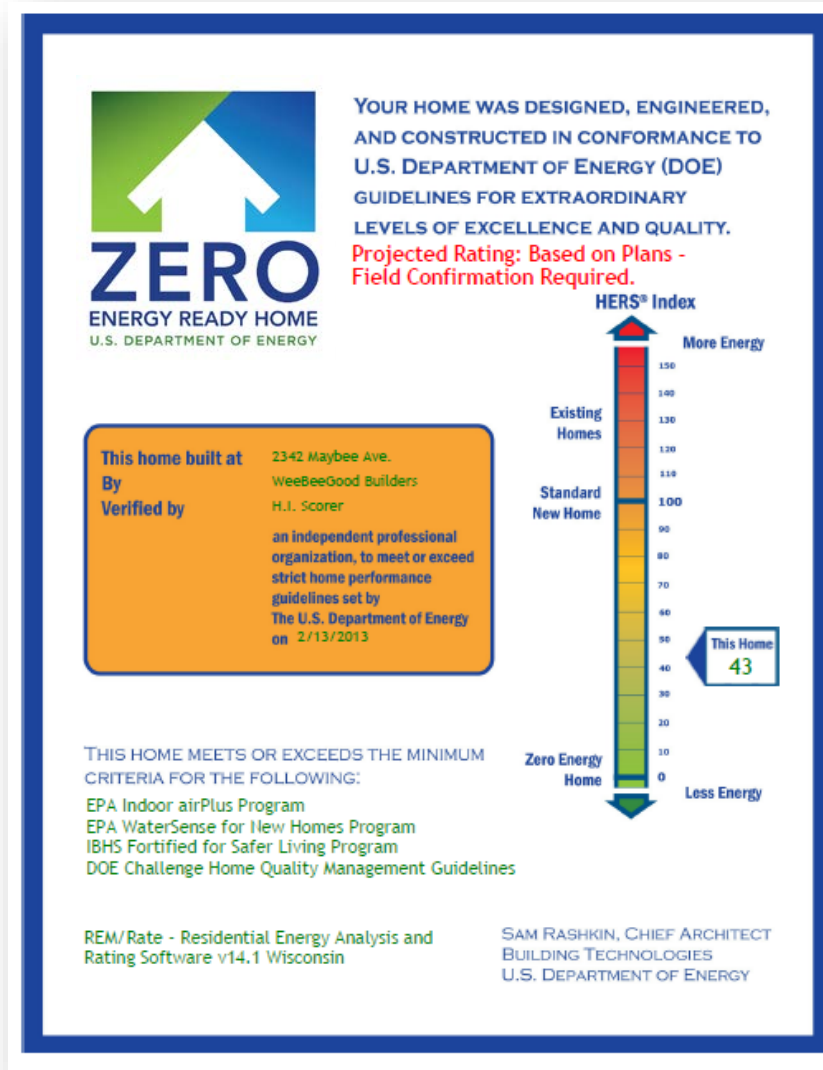
# Lots of Recognition Choices...

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



- **Rater Prints Certificate**  
directly from rating software
- **Certificate Includes:**
  - Rating Details
  - Graphic HERS Index
  - Optional Programs





Independent Voice of Authority vs. “Trust me.”

## Links Buyers to Leading Edge Builders:

- Contact Information
- Optional Commitments:
- # Labeled Homes
- Website link



## For All Active Partners

### DOE Zero Energy Ready Home Partner Locator

Builders across the United States have become DOE Zero Energy Ready Home partners. The interactive map below allows you to view the number of partners by state and organizational type. Search for partners by typing into the text box below. You may also find partners by state, organization type, or commitments.

#### Ready to Take the Zero Energy Ready Challenge?

Builders interested in learning more about DOE Zero Energy Ready Home can [view the requirements](#) or start the [sign up process](#).

Search Partners:

Search

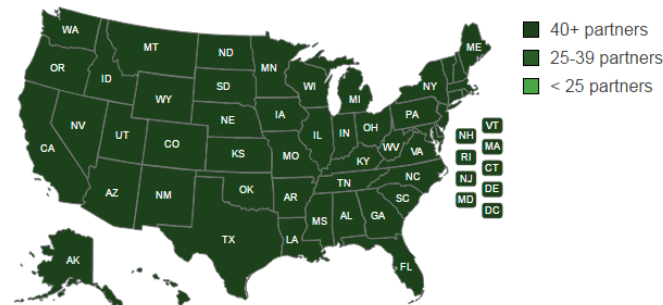
Or Filter By:

State:

All

Partner Type:

All





# Recognition with ZERH Locator

## DOE Zero Energy Ready Home: Results

[Back to Map](#)

Name	Type	HIA Winner	City	State	DOE ZERH Projects	Builders Challenge Homes
<b>100% Partners</b>						
Palo Duro Homes, Inc.	Builder	2013, 2014, 2015	Farmington	NM	208	235
Mandalay Homes	Builder	2013, 2014, 2015, 2016	Phoenix	AZ	183	0
Thrive Home Builders	Builder	2013, 2014, 2015, 2016, 2016	Denver	CO	169	0
Mutual Housing California	Builder	2015	Sacramento	CA	62	0
Habitat for Humanity So. Sarasota, Inc.	Builder	2014, 2015, 2016	Venice	FL	21	0
Greenhill Contracting Inc.	Builder	2014, 2015, 2015, 2015, 2016, 2016	ESOPUS	NY	20	9
Charles Thomas Homes	Builder	2015	Elkhorn	NE	18	0
Amaris Homes, LLC	Builder	2015, 2016	Maplewood	MN	10	4
TCLegendHomesLLC	Builder	2013, 2014, 2015, 2016, 2016, 2016, 2016, 2016	Bellingham	WA	9	0

## DOE Zero Energy Ready Home: Partner Profile

### Mandalay Homes



**Partner ID:**

620

**Organization Type:**

Builder

**Main Contact:**

Dave Everson

**Address:**

2320 E BASELINE RD #148-605  
PHOENIX, AZ 85042

**Primary Phone Number:**

(602) 864-3800

**Certified DOE Zero Energy Ready Homes  
(2012 - Present):**

183

**Certified Builders Challenge Homes  
(2008 - 2012):**

0

**Website:**

<http://www.mandalayhomes.com>

# Recognition with 'Brand'



# Recognition with 'Brands'



## Homes to the Power of **ZERO**



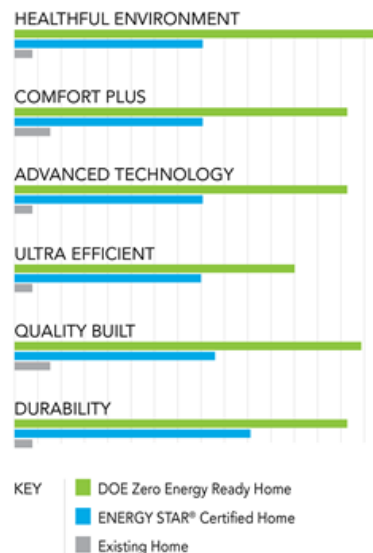
### What is the DOE Zero Energy Ready Home™ Label?

It is a Symbol of Excellence for energy savings, comfort, health, quality, and durability met by a select group of leading builders meeting U.S. Department of Energy Guidelines.

### What is a Zero Energy Ready Home?

It is a high-performance home so energy efficient, all or most annual energy consumption can be offset with renewable energy. In other words, it is the Home of the Future.

### A Symbol of Excellence



This graphic comparison chart demonstrates relative performance of this DOE Zero Energy Ready Home to existing homes (built between 1990 and 2010) and ENERGY STAR Certified Homes. Actual performance may vary.



303-231-4567  
ThriveHomeBuilders@net.com  
123 Main Street, Denver, CO 34567



# Recognition with Value Message

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Front Cover

### Lives Better

**HEALTHFUL ENVIRONMENT**

Every DOE Zero Energy Ready Home has a comprehensive package of measures to minimize dangerous pollutants, provide continuous fresh air, and effectively filter the air you breathe.

**COMFORT PLUS**

Superior insulation, windows, air sealing and space conditioning systems included in every DOE Zero Energy Ready Home surround you with even temperatures, low-humidity, and quiet in every room on every floor.

**KEY**

- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home

### Works Better

**ADVANCED TECHNOLOGY**

Every DOE Zero Energy Ready Home begins with solid building science specified by ENERGY STAR for Homes, and then adds advanced technologies and practices from DOE's world-class research program, Building America.

**ULTRA EFFICIENT**

Compared to a typical home, an ultra efficient Zero Energy Ready Home is inexpensive to own. In fact, every DOE Zero Energy Ready Home is so energy efficient, a small solar electric system can easily offset most, or all, of your annual energy consumption. We call this Zero Net-Energy Ready.

### Lasts Better

**QUALITY BUILT**

Advanced construction practices and technologies are specified for every DOE Zero Energy Ready Home. Then they are enforced by independent verifiers with detailed checklists and prescribed diagnostics.

**DURABILITY**

The advanced levels of energy savings, comfort, health, durability, quality and future performance in every DOE Zero Energy Ready Home provide value that will stand the test of time, and will meet and exceed forthcoming code requirements.

LEARN MORE AT: [buildings.energy.gov/zero](http://buildings.energy.gov/zero)

Inside Spread

## The Future of Housing—Today

Only a select group of the top builders in the country meet the extraordinary levels of excellence and quality specified by U.S. Department of Energy guidelines.

**ZERO ENERGY READY HOME**  
U.S. DEPARTMENT OF ENERGY

LEARN MORE AT:  
[buildings.energy.gov/zero](http://buildings.energy.gov/zero)

**thrive**  
HOME BUILDERS

303-231-4567  
[ThriveHomeBuilders@net.com](mailto:ThriveHomeBuilders@net.com)  
123 Main Street, Denver, CO 34567

### A Symbol of Excellence

**HEALTHFUL ENVIRONMENT**

**COMFORT PLUS**

**ADVANCED TECHNOLOGY**

**ULTRA EFFICIENT**

**QUALITY BUILT**

**DURABILITY**

**KEY**

- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home

This label indicates relative performance of this DOE Zero Energy Ready Home to existing homes (built between 1990 and 2010) and ENERGY STAR Certified Homes. Actual performance may vary.

**U.S. DEPARTMENT OF ENERGY**

Flap

Back Cover





303-231-4567  
ThriveHomeBuilders@net.com  
123 Main Street, Denver, CO 34567

## VIVID LIVING HEALTHFUL ENVIRONMENT



### Fresh Air

- Supply Fresh Air System
- Odor and Moisture Control Fans
- High-Capture Filtration Technology

### Quiet

- Quiet Window Technology
- Quiet Wall Technology

### Moisture Control

- Dry-by-Design Construction
- Moisture Control System – Whole House
- Moisture Controlled Comfort System
- Moisture Controlled Windows
- Moisture Controlled Lower Level

### Pest Control

- Bug Control Barrier
- Pest Screened Home

### Outdoor Contaminant Control

- Contaminant Sealed Construction
- Contaminant Sealed Comfort Delivery
- Dust and Pollen Barrier
- Radon Controlled Home

### Chemical Control

- Formaldehyde Controlled Home
- VOC Controlled Home

### Fume Control

- Carbon Monoxide Controlled Equipment
- Carbon Monoxide Controlled Fireplace
- Fume Controlled Garage

Vivid Living • 42 Sample Street, Suite 500, Anytown, MA 02460 • 617.467.3902 • [www.vividliving.com](http://www.vividliving.com)

# Recognition with Awards



Housing Innovation  
Award

# Recognition with Awards

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

[Home](#) | [About](#) | [Your Team](#) | [Accolades](#) | [Testimonials](#) | [Videos](#) | [Login](#)



Find Your  
Home

Design Your  
Home

Browse Our  
Galleries

Latest News

Contact Us



[Why Cobblestone Channel](#) | [Innovation Channel](#) | [Cobblestone Care Channel](#)

## Michigan's Most Respected Builder

### CONTACT US



**Sales:** (989) 692-0210

**Office:** (989) 692-0140

**Fax:** (989) 692-0142

**Design Studio Address:**

5474 Garfield Rd  
Suite 2  
Saginaw, MI 48603  
[MAP](#)

**Mailing Address:**

P.O. Box 604  
Freeland, MI 48623  
[EMAIL](#)



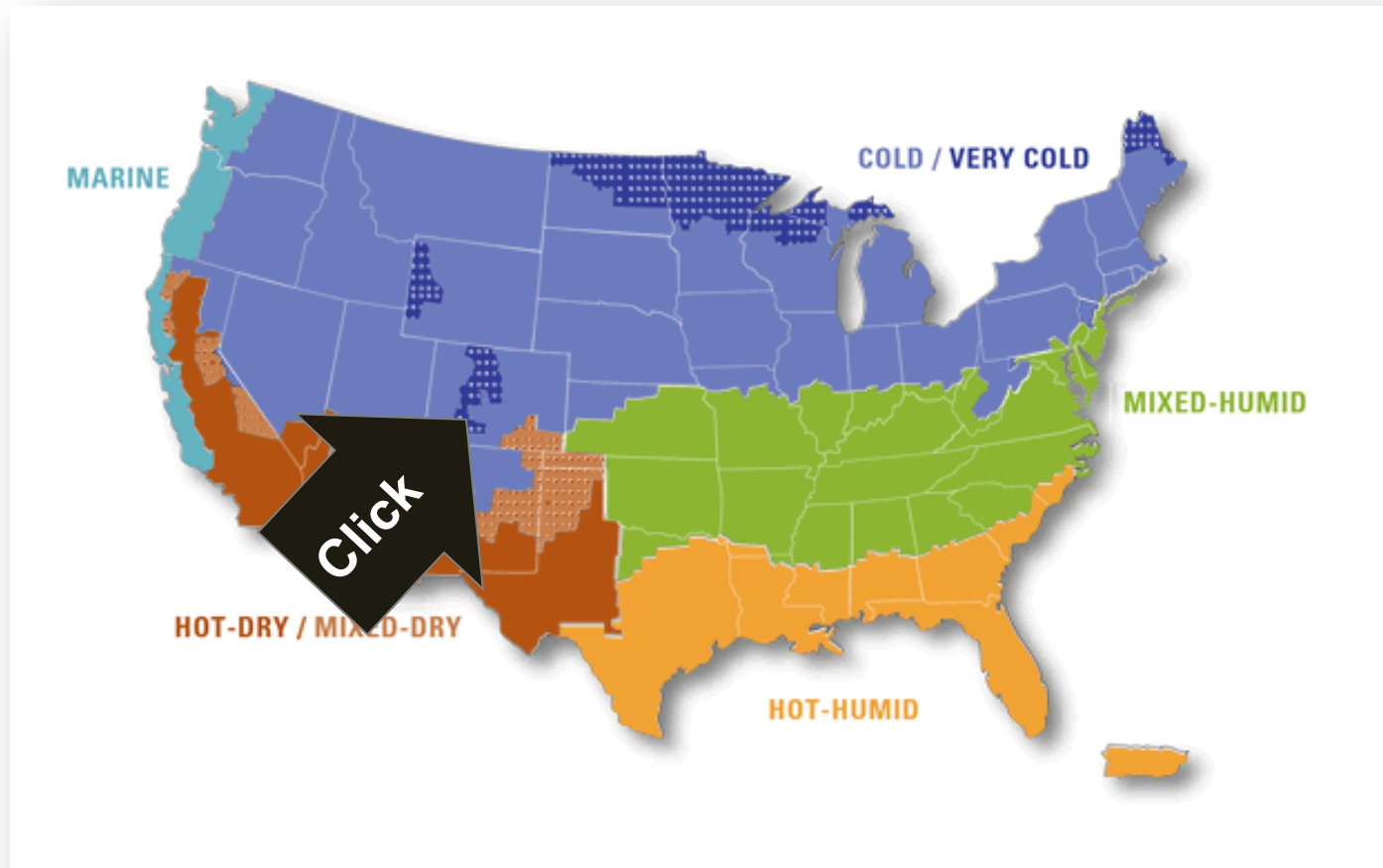
# Recognition with Awards

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Recognition with Tour of Zero



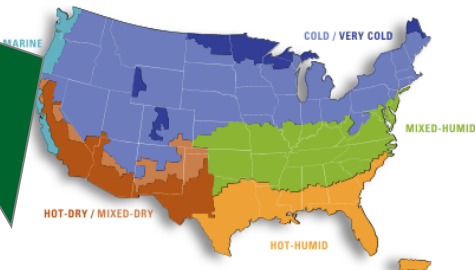
# Recognition with Tour of Zero

Home > Residential Buildings > Zero Energy Ready Home > DOE Tour of Zero

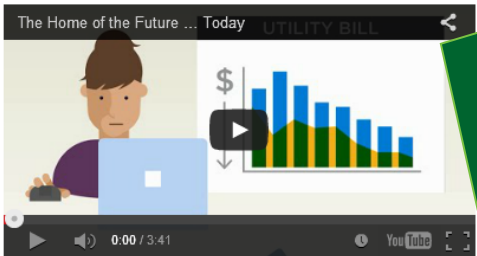
## DOE TOUR OF ZERO

- Buildings Home
- About
- Emerging Technologies
- Residential Buildings
- Building America
- Home Energy Score
- Home Performance with ENERGY STAR
- Better Buildings
- Residential Buildings
- Partners
- Partners
- Become a Partner
- Program Requirements
- Partner Locator
- Zero Energy Home Tour
- Student Competition
- Housing Innovation Awards
- Resources
- Events
- Guidelines for Home Energy Professionals
- Commercial Buildings
- Appliance & Equipment Standards
- Building Energy Codes
- Success Stories
- Resource Center
- Funding Opportunities

Are you ready for a home that lives, works, and lasts better? The home of the future - [a better home](#) - is available today. Take a virtual tour of homes that are so energy efficient a renewable energy system can offset all or most of their annual energy consumption. These award-winning homes are independently certified to meet DOE Zero Energy Ready Home [guidelines](#) and constructed by a select group of [top builders](#). Zero Energy Ready Home is part of the U.S. Department of Energy's Better Buildings initiative. Better Buildings aims to make commercial, industrial, public, and residential buildings 20 percent more energy efficient over the next decade.



Click on a climate zone to see homes in that region.



[The Home of the Future Today Video \(Text Version\)](#)

Search:

Showing 1 to 25 of 77 entries

Show  entries

TOUR THESE HOMES	BUILDER	LOCATION	HIA WINNER	CLIMATE ZONE
<a href="#">Cobbler Lane</a>	<a href="#">Addison Homes</a>	Greer, SC	2015	MIXED-HUMID
<a href="#">Fishers Circle</a>	<a href="#">Amaris Homes</a>	Maplewood, MN	2015	COLD / VERY COLD
<a href="#">Johns Island Custom</a>	<a href="#">Amerisips Homes, LLC</a>	Charleston, SC	2014	HOT-HUMID
<a href="#">Eco-Village Ithaca</a>	<a href="#">AquaZephyr</a>	Ithaca, NY	2014	COLD / VERY COLD
<a href="#">ZED 2</a>	<a href="#">Boulder ZED Design Build</a>	Boulder, CO		COLD / VERY COLD



## National Campaign:

### Call to Action:

Inspire American homebuyers and home owners to visit the future of housing available today with DOE Zero Energy Ready Certified Homes.

### Campaign Partners:

- Manufacturers
- Associations
- NGO's
- Financial Institutions





## Drop-In Messaging

As a registered DOE Zero Energy Ready Home partner, enjoy access to the following pre-approved messages for insertion into your promotional materials. Simply insert your company name and use the message as it appears below.

- According to the U.S. Department of Energy, **<Partner Name>** is in a select group of top builders in the nation who have certified one or more homes that meet or exceed Zero Energy Ready Home guidelines for excellence in performance and energy efficiency.
- As a committed DOE partner who provides certified Zero Energy Ready Homes, **<Partner name>** is in the top one percent of builders in the country meeting the extraordinary levels of excellence in energy and performance specified in the national program requirements.
- As a Zero Energy Ready Home Partner, **<Partner Name>** offers high performance homes that are so energy efficient, all or most of their annual energy consumption can be offset with renewable energy.
- **<Partner name>** builds homes certified to rigorous DOE Zero Energy Ready Home National Guidelines that are at least 40%-50% more energy efficient than a typical new home.
- **Healthful environment:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home has a comprehensive package of measures to help minimize dangerous pollutants, provide continuous fresh air, and effectively filter the air you breathe.
- **Comfort Plus:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home features high-efficiency insulation, windows, air sealing and space conditioning systems that help surround you with even temperatures, low-humidity, and quiet in every room on every floor.
- **Advanced Technology:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home features advanced technologies and practices recommended by leading housing experts from DOE's world-class research program, Building America.

- **Ultra efficient:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home is so energy efficient a small solar electric system can easily offset most, or all, of its annual energy consumption. This is why it is called as Zero Energy Ready Home.
- **Quality Built:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home features high-efficiency appliances and equipment that are often associated with better quality construction. In addition, overall quality is enhanced with rigorous inspections, diagnostics, and checklists enforced by independent verifiers.
- **Durability:**  
According to the U.S. Department of Energy (DOE), every certified Zero Energy Ready Home features advanced levels of energy savings, comfort, health, durability, quality and future performance that can be expected to stand the test of time and help enhance future value.
- Samuel Rashkin, Chief Architect for DOE Building Technologies Office, said "Zero Energy Ready Homes like those constructed by **<Partner Name>** are the home of the future because they live, work, and last better with incredibly low or no energy costs. And what's exciting for American homebuyers, they are available today thanks to leading builders across the country."
- "Housing Innovation Award winners such as **<Partner Name who has won HIA>** are leading a major housing industry transformation to zero energy ready homes. This level of performance is the home of the future because it improves the way Americans live by substantially reducing or eliminating utility bills, ensuring engineered comfort way beyond traditional homes, protecting health with a comprehensive package of indoor air quality measures, and helping maximize the largest investment of a lifetime," said Sam Rashkin, Chief Architect at the U.S. Department of Energy's Building Technologies Office.

# Recognition with 'Voice of Authority'

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

## VIRTUAL-STRATEGY MAGAZINE

your leading source for virtualization news

Subscribe to our newsletter!



Featured Company



Featured Company



HP EliteBook  
Revolve 810



Technology that moves to where the business is.

Discover how mobility motivates your customers. Choose business tablets, notebooks and 2 in 1s from HP with Intel Inside.\* [Learn more >>](#)



Featured Company



HOME

NEWS

FEATURES

VIRTUAL-THREAD

DIRECTORY

FINANCE

RESEARCH

IT JOBS

IT STORE

ABOUT VSM

IIR's 4th Annual Network Virtualization Forum | September 15 - 17 2015 Melia Avenida, Madrid | SDN NFV VNF LSO

### Topics

Virtualization  
Cloud  
Big Data  
Application  
Storage  
Server  
Security  
Networking  
Desktop  
Infrastructure  
Disaster  
Recovery

## Garbett Homes Partnership with Energy Department Brings Zero Energy Ready Homes Within Reach

PRWeb

Thursday, June 18th 2015



*Community of Homes Designed,  
Engineered and Constructed for  
Extraordinary Levels of Excellence;  
Ranks in Top 1 Percent of Homes in the  
Nation for Quality and Energy Efficiency  
Specified by U.S. Department of Energy  
Guidelines*

Search VSM

**Search**

Advanced

According to DOE, Zero Energy Ready Homes are the homes of the future because they meet or exceed next generation energy codes and include substantial innovations and best practices recommended by leading housing experts working with the DOE Building America program. Homebuyers can buy these visionary homes today, including Treseder, which is available for sale now with the model home opening on August 1, 2015. By meeting or exceeding DOE requirements, these

Enter Symbol levels of energy savings, comfort, health and durability.

Quotes delayed 20 min.



Homes that do more.

Sign In

Register

Find Your  
New Home

Energy  
Efficient  
Living

Colorado's  
Builder

Design  
Studio

Customer  
Care &  
Warranty

Contact Us

*"Zero Energy Ready Homes are the future of U.S. housing, and innovators like New Town Builders are leading the way for the entire industry. Zero Energy Ready Homes can provide a vastly superior homeowner experience at a lower ownership cost – an experience all Americans should want in their next home."*

*Sam Rashkin, Chief Architect for U.S. Department of Energy Building Technologies Office*



## Your Zero Energy Ready Home Story



— BROUGHT TO YOU BY —

**Thrive Home Builders**

303-231-4567

ThriveHomeBuilders@net.com

123 Main Street, Denver, CO 34567





## Welcome to Your Zero Energy Ready Home

### THIS IS YOUR STORY.

The story of your Zero Energy Ready Home and how it leverages advanced technology for a better homeowner experience.

### IN THIS BROCHURE

you will learn about the following seven complete systems and why they make your home so special.



High-Performance Thermal Enclosure



Whole-House Water Protection



High-Performance Comfort System



High-Efficiency Components



Whole-House Health Protection



Solar-Ready Construction



Enhanced Quality Assurance



## High-Performance Thermal Enclosure



**The roof, walls, windows, doors, and foundation combine to form your home's enclosure.** You've got one chance to get it right during construction before it's locked in for the next few hundred years. That's why your home includes the leading expert recommendations for advanced thermal protection that provide significant utility bill savings along with enhanced comfort and durability.



### High-Performance Windows

use advanced technology to keep heat in during the winter and out during the summer while brightening your living space all year long.



### High-Performance Insulation

provides a complete thermal blanket that snugly surrounds your home in comfort and quiet.



### Comprehensive Draft Protection

is like wrapping your house in money with much lower heating and cooling bills while also blocking annoying dust, pollen, pests, noise, and moisture.

#### TIP

Any time work is being done on your home that involves wall penetrations or workers in your attic, make sure the contractor is required to maintain the insulation levels and air-tight construction.



- **Review**

- Technical Guidelines
- Partnership Agreement Terms

- **Register**

- Electronically Sign Agreement

- **Choose Optional Commitments:**



100% of homes meet DOE Zero Energy Ready Home Guidelines



Homes meet EPA's WaterSense Guidelines



Homes meet IBHS's Fortified Home Guidelines



Meet DOE ZERH Home Quality Management Program

- **Take Orientation Training**  
after registering and renew training every year
- **Provide Certificate**  
for DOE Zero Energy Ready Home to each home owner
- **Adhere to Brand Identity Guidelines**  
for proper use of the DOE Zero Energy Ready Home name and logo
- **Build/Verify at Least One Home/Year**  
to maintain active partnership

To view the full Agreement terms and disclaimers, visit:

<http://www1.eere.energy.gov/buildings/zero/>

- Update Company Information;
- Add, Delete, and Edit Contacts;
- Add/Update Your Logo;
- Add Commitments; and
- Access Key Tools and Resources

# Final Word





An aerial photograph of New York City, showing the dense urban landscape of Manhattan and the surrounding areas. The Hudson River is visible on the left, and the East River is on the right. The city is characterized by a high concentration of skyscrapers and buildings, particularly in the lower Manhattan area. The text is overlaid on the upper left portion of the image.

***“The earth is not inherited from our fathers  
but borrowed from our children.”***

Native Proverb



***“Who we are is what we leave behind.”***

Subaru ‘Stop Waste’ Campaign



# Thank You



**For More Information:**

[www.buildings.energy.gov/zero/](http://www.buildings.energy.gov/zero/)

**Email Contact:**

[zero@newportpartnersllc.com](mailto:zero@newportpartnersllc.com)



# Zero Energy Ready Home Training

## **Alternate Slides**

# Performance Path Example

## CZ2 Prototype - 4 BR, 3500 SF

Specification	Target Home Spec	Design Home
Mandatory Items: ducts in conditioned space; 2012 IECC insulation; etc.		Meets all mandatory items; uses total UA to meet insulation reqmnt.
Windows	U=0.40; SHGC=0.25	U=0.32; SHGC=0.24
Infiltration	3 ACH50	2.5 ACH50
Duct Leakage	Total $\leq 8$ CFM25 per 100 SF of CFA; Leakage to outdoors $\leq 4$ CFM25 per 100 SF of CFA	Total leakage $\leq 280$ CFM25 Leakage to outdoors $\leq 140$ CFM25
Furnace AFUE	80	92
A/C SEER	18	16
Whole-House Mech. Vent.	75 cfm; 1.4 cfm/W;	75 cfm; 5.0 cfm/W
Water Heater	ENERGY STAR	Gas storage 0.67 EF
Target Home HERS Index	55; (52 with SAF)	
HERS Index – Design Home		52 – <b>COMPLIES!</b>



# Performance Path Example

## CZ4 Prototype - 4 BR, 2400 SF

Specification	Target Home Spec	Design Home
AGW Insulation	R20 or R13+5	R21
Attic Insulation	R49 (U=0.026)	R50
Basement Walls	R10/13	R10
Windows	U=0.30; SHGC=0.27	U=0.30; SHGC=0.27
Infiltration	2.5 ACH50	3.0 ACH50
Ducts	Total $\leq 8$ CFM25 per 100 SF of CFA; Leakage to outdoors $\leq 4$ CFM25 per 100 SF of CFA	Total leakage 288 CFM25 Leakage to outdoors 140 CFM25
Furnace AFUE	90	90
A/C SEER	15	15
Whole-House Mech. Vent.	77 cfm; 1.4cfm/W no heat exchange;	77 cfm; 8.0 cfm/W exhaust-only
Water Heater	ENERGY STAR	Gas storage 0.67 EF
<b>HERS Index</b>	<b>52</b>	<b>52 COMPLIES!</b>

# Performance Path Example

## CZ5 Prototype - 4 BR, 2400 SF

Specification	Target Home Spec	Design Home
AGW Insulation	R20 or R13+5	R20
Attic Insulation	R49 (U=0.026)	R50
Basement Walls	R15/19	R10
Windows	U=0.27; SHGC=0.40	U=0.32; SHGC=0.30
Infiltration	2.0 ACH50	2.0 ACH50
Ducts	Total ≤ 8 CFM25 per 100 SF of CFA; Leakage to outdoors ≤ 4 CFM25 per 100 SF of CFA	Total leakage 288 CFM25 In Conditioned Space w/ ½ ACH50 (Req.'d by ENERGY STAR) – Exempt
Furnace AFUE	94	90
A/C SEER	13	13
Whole-House Mech. Vent.	77 cfm; 1.2cfm/W balanced;	77 cfm; 8.0 cfm/W exhaust-only
Water Heater	ENERGY STAR	Gas storage 0.67 EF
<b>HERS Index</b>	<b>52</b>	<b>52 COMPLIES!</b>



# Performance Path Example

## CZ5 Prototype - 4 BR, 2400 SF

Specification	Target Home Spec	Design Home
AGW Insulation	R20 or R13+5	R20
Attic Insulation	R49 (U=0.026)	R50
Basement Walls	R15/19	R10
Windows	U=0.27; SHGC=0.40	U=0.32; SHGC=0.30
Infiltration	2.0 ACH50	2.0 ACH50
Ducts	Total ≤ 8 CFM25 per 100 SF of CFA; Leakage to outdoors ≤ 4 CFM25 per 100 SF of CFA	Total leakage 288 CFM25 In Conditioned Space w/ ½ ACH50 (Req.'d by ENERGY STAR) – Exempt
Furnace AFUE	94	90
A/C SEER	13	13
Whole-House Mech. Vent.	77 cfm; 1.2cfm/W balanced;	77 cfm; 8.0 cfm/W exhaust-only
Water Heater	ENERGY STAR	Gas storage 0.67 EF
<b>HERS Index</b>	<b>52</b>	<b>52 COMPLIES!</b>

# Performance Path Example

## CZ6 Prototype - 4 BR, 2400 SF

Specification	Target Home Spec	Design Home
AGW Insulation	R20+5 or R13+10	21+5
Attic Insulation	R49 (U=0.026)	R50
Basement Walls	R15/19	R10
Windows	U=0.27; SHGC=0.40	U=0.32; SHGC=0.30
Infiltration	2.0 ACH50	2.5 ACH50
Ducts	Total $\leq$ 8 CFM25 per 100 SF of CFA; Leakage to outdoors $\leq$ 4 CFM25 per 100 SF of CFA	In Conditioned Space Total leakage 316 CFM25 Outdoors 120 CFM25
Furnace AFUE	94	95
A/C SEER	13	13
Whole-House Mech. Vent.	77 cfm; 1.2cfm/W balanced;	77 cfm; 8.0 cfm/W exhaust-only
Water Heater	ENERGY STAR	Gas storage 0.67 EF
<b>HERS Index</b>	<b>46</b>	<b>46 COMPLIES!</b>

## Climate Zones 1 and 2:

Walls: R-13 (R-13+5 recommended by CH)

Ceiling: R-30 (CZ1); R-38 (CZ2)

Floor: R-13 (R-19 recommended by CH)

Basement: R-0

Crawl Space: R-0

Slab: R-0

## Climate Zone 1:

Walls: R-13 (R-13+5 recommended by CH)

Ceiling: R-30

Floor: R-13 (R-19 recommended by CH)

Basement: R-0

Crawl Space: R-0

Slab: R-0

## Climate Zone 2:

Walls: R-13 (R-13+5 recommended by CH)

Ceiling: R-38

Floor: R-13 (R-19 recommended by CH)

Basement: R-0

Crawl Space: R-0

Slab: R-0

## Climate Zone 3:

Walls: R-20 or R-13+5

Ceiling: R-38

Floor: R-19

Basement: R-5/13

Crawl Space: R-5/13

Slab: R-0 (**R-5 recommended by CH**)



## Climate Zone 2:

**Walls:** R-13  
(R-13+5 Recommended)

**Ceiling:** R-38

**Floor:** R-13

**Basement:** R-0

**Crawl Space:** R-0

**Slab:** R-0

## Climate Zone 3:

**Walls:** R-20 or R-13+5  
(R-13+5 Recommended)

**Ceiling:** R-38

**Floor:** R-19

**Basement:** R-5/13

**Crawl Space:** R-5/13

**Slab:** R-0  
(R-5 Recommended)

## Climate Zone 4:

Walls: R-20 or R-13+5

Ceiling: R-49

Floor: R-19

Basement: R-10/13

Crawl Space: R-10/13

Slab: R-10 for 2 ft. depth

	CZ 2	CZ 4
Walls	R-13 (rec. R13+5)	R-20 or R-13+5 (rec. R-13+5)
Ceiling	R-38	R-49
Floor	R-13	R-19
Basement	R-0	R-10/13
Crawl Space	R-0	R-10-13
Slab	R-0 (rec. R-5 slab edge)	R-10 , 2' Deep

## **Climate Zone 5:**

Walls: R-20 or R-13+5

Ceiling: R-49

Floor: R-30

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 2 ft. depth

	CZ 2	CZ 3
Walls	R-13 (rec. R13+5)	R-20 or R-13+5 (rec. R-13+5)
Ceiling	R-38	
Floor	R-13	R-19
Basement	R-0	R-5/13
Crawl Space	R-0	R-5-13
Slab	R-0 (rec. R-5 slab edge)	

	CZ 4	CZ 5
Walls	R-20 or R-13+5	
Ceiling	R-49	
Floor	R-19	R-30
Basement	R-10/13	R-15/19
Crawl Space	R-10/13	R-15-19
Slab	R-10 for 2' Deep	



	<b>CZ 5 IECC 2012</b>	<b>CZ 5 IECC 2012 RI</b>
Walls	R-20 or R-13+5	
Ceiling	R-49	R-38
Floor	R-30	
Basement	R-15/19	R-13/10
Crawl Space	R-15/19	R-13/10
Slab	R-10/2 ft. Deep	
Window	U-0.32	U-0.35

	CZ 5	CZ 6
Walls	R-20 or R-13+5	R-20+5 or R-13+10
Ceiling	R-49	
Floor	R-30	
Basement	R-15/19	
Crawl Space	R-15/19	
Slab	R-10/2' Deep	R-10/4' Deep

## Climate Zone 6:

Walls: R-20+5 or R-13+10

Ceiling: R-49

Floor: R-30

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 4 ft. depth

## Climate Zone 7:

Walls: R-20+5 or R-13+10

Ceiling: R-49

Floor: R-38

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 4 ft. depth

## Climate Zone 5:

Walls: R-20 or R-13+5

Ceiling: R-49

Floor: R-30

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 2 ft. depth

## Climate Zone 6:

Walls: R-20+5 or R-13+10

Ceiling: R-49

Floor: R-30

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 4 ft. depth

	Climate Zone 6	Climate Zone 7
Walls	R-20+5 or R-13+10	
Ceiling	R-49	
Floor	R-30	R-38
Basement	R-15/19	
Crawl Space	R-15/19	
Slab	R-10/4' Deep	



## Zone 6:

Walls: R-20+5 or R-13+10

Ceiling: R-49

Floor: R-30

Basement: R-15/19

Crawl Space: R-15/19

Slab: R-10 for 4 ft. depth

## Zone 7:

R-20+5 or R-13+10

R-49

**R-38**

R-15/19

R-15/19

R-10 for 4 ft. depth

	CZ 5	CZ 6
Walls	R-20 or R-13+5	R-20+5 or R-13+10
Ceiling	R-49	
Floor	R-30	
Basement	R-15/19	
Crawl Space	R-15/19	
Slab	R-10/2' Deep	R-10/4' Deep

## **Ceiling, wall, floor, and slab insulation:**

Exceed 2012 WA State Energy Code Levels  
[Tables 402.1.1 and 402.1.3]

## **Wall U-Value:**

$\leq 0.043$

[e.g., R-21 wall insulation AND R-5 contin. foam]

# Prescriptive Requirements

Climate Zone	Fenestration	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value
1	NR	0.75	0.25	30	13
2	0.40	0.65	0.25	38	13
3	0.35	0.55	0.25	38	20 or 13+5 <sup>h</sup>
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>h</sup>
5 & Marine 4	0.32	0.55	NR	49	20 or 13+5 <sup>h</sup>
6	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>
7 & 8	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>

# Prescriptive Requirements (cont.)

Climate Zone	Mass Wall R-Value <sup>i</sup>	Floor R-Value	Basement <sup>c</sup> Wall R-Value	Slab <sup>d</sup> R-Value, Depth	Crawl Space <sup>c</sup> Wall R-Value
1	3/4	13	0	0	0
2	4/6	13	0	0	0
3	8/13	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	8/13	19	10 /13	10, 2 ft	10/13
5 & Marine 4	13/17	30 <sup>g</sup>	15/19	10, 2 ft	15/19
6	15/20	30 <sup>g</sup>	15/19	10, 4 ft	15/19
7 & 8	19/21	38 <sup>g</sup>	15/19	10, 4 ft	15/19

# Equivalent U-Factors <sup>a</sup>

Climate Zone	Fenestration	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor
1	0.50	0.75	0.035	0.082
2	0.40	0.65	0.030	0.082
3	0.35	0.55	0.030	0.057
4 except Marine	0.35	0.55	0.026	0.057
5 & Marine 4	0.32	0.55	0.026	0.057
6	0.32	0.55	0.026	0.048
7 & 8	0.32	0.55	0.026	0.048

<sup>A</sup> Non-fenestration U-factors shall be obtained from measurement, calculation, or an approved source.



# Equivalent U-Factors (cont.)

Climate Zone	Mass Wall U-Factor <sup>b</sup>	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor
1	0.197	0.064	0.360	0.477
2	0.165	0.064	0.360	0.477
3	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.098	0.047	0.059	0.065
5 & Marine 4	0.082	0.033	0.050	0.055
6	0.060	0.033	0.050	0.055
7 & 8	0.057	0.028	0.050	0.055

<sup>b</sup> When more than half of insulation is on interior, following maximum U-factors apply: CZ1-0.17, CZ2 – 0.14, CZ3 – 0.12, CZ4 (except Marine) – 0.087, CZ5 CZ4 Marine – 0.065, CZ6 -8 – 0.057.

State	Applicable to Homes with the Following Permit Date
MA	On or after 01/01/2015
DC, IL, MD, RI	On or after 04/01/2015 (07/01/2015 for some counties).
IA	On or after 06/01/2015
DE	On or after 12/01/2015
MT, OR, WA	On or after 01/01/2016
MN	On or after 04/01/2016
NV	On or after 07/01/2016
NJ	On or after 04/01/2017
TX	On or after 10/01/2017

# Showcase: Tour of Zero

- [Guidelines for Home Energy Professionals](#)
- [Commercial Buildings](#)
- [Appliance & Equipment Standards](#)
- [Building Energy Codes](#)
- [Success Stories](#)
- [Resource Center](#)
- [Funding Opportunities](#)
- [Events & Webinars](#)

Search:

Search

Reset

Showing 1 to 9 of 9 entries (filtered from 77 total entries)

Show 25 entries

TOUR THESE HOMES	BUILDER	LOCATION	HIA WINNER	CLIMATE ZONE
<a href="#">Double ZeroHouse</a>	<a href="#">KB Home</a>	Los Angeles, CA	2014	HOT-DRY / MIXED-DRY
<a href="#">Double ZeroHouse 3.0</a>	<a href="#">KB Home</a>	Los Angeles, CA	2015	HOT-DRY / MIXED-DRY
<a href="#">Santalina, Haciendas at Rancho ZeroHouse 2.0</a>	<a href="#">KB Home</a>	San Marcos, CA	2013	HOT-DRY / MIXED-DRY
<a href="#">Gordon Estates</a>	<a href="#">Mandalay Homes</a>	Phoenix, AZ	2013	HOT-DRY / MIXED-DRY
<a href="#">Vision Hill Lot 1</a>	<a href="#">Mandalay Homes</a>	Prescott, AZ	2015	HOT-DRY / MIXED-DRY
<a href="#">Mutual Housing at Spring Lake</a>	<a href="#">Mutual Housing California</a>	Sacramento, CA	2015	HOT-DRY / MIXED-DRY
<a href="#">Advanced Efficiency Home</a>	<a href="#">Palo Duro Homes</a>	Albuquerque, NM	2013	HOT-DRY / MIXED-DRY
<a href="#">Aztec House</a>	<a href="#">Palo Duro Homes</a>	Albuquerque, NM	2014	HOT-DRY / MIXED-DRY
<a href="#">Via del Cielo</a>	<a href="#">Palo Duro Homes</a>	Albuquerque, NM	2015	HOT-DRY / MIXED-DRY



Previous

1

Next

# Showcase: Tour of Zero

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

**ENERGY.GOV**  
Office of Energy Efficiency & Renewable Energy

SERVICES EFFICIENCY RENEWABLES TRANSPORTATION ABOUT US OFFICES

Home » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES





"WHEN I SAW MY FIRST BILL AND I COMPARED IT TO MY LAST HOME'S BILL, I WAS SO IMPRESSED."

**Mandalay Homes**  
  
Gordon Estates  
Phoenix, AZ  
mandalayhomes.com

**ZERO**  
ENERGY READY HOME  
U.S. DEPARTMENT OF ENERGY

KEY FEATURES

- High-performance insulation system for enhanced quiet and comfort.
- Comprehensive draft protection
- Fresh air system for cleaner, healthier indoor air
- High-efficiency comfort system
- High-efficiency appliances and advanced lighting technology for energy and water savings

[Read more.](#)



Mandalay Homes  
Gordon Estates

[More...](#)

[Meet the Builder](#)

**1,915 ft<sup>2</sup>**  
3 bedrm, 2 bath  
2 floors  
marino climate

**HERS -1**  
This home's score vs PV  
8 = a net zero energy home  
100 = typical new code home  
130 = average existing home

**-\$94**  
Average monthly energy bill\*

\$2,677 saved per year\*\*  
\$13,853 saved over 20-yr mortgage\*\*  
\*Based on utility charges and \$0.12/kWh  
PV credit: \$0.04/kWh. \*\*Assumes 2014 DOE Annual Energy Outlook

# Showcase: Tour of Zero

[Home](#) » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES





# Showcase: Tour of Zero

[Home](#) » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES





# Showcase: Tour of Zero

[Home](#) » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES



In addition to DOE Zero Energy Ready Home certification, all homes meet the requirements of ENERGY STAR Certified Homes and EPA's WaterSense and Indoor airPLUS programs.

4 of 12



# Showcase: Tour of Zero

[Home](#) » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES



# Showcase: Tour of Zero

[Home](#) » DOE Tour of Zero: Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES





# Showcase: Tour of Zero

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

"WHEN I SAW MY FIRST BILL AND I COMPARED IT TO MY LAST HOME'S BILL, I WAS SO IMPRESSED."

## Mandalay Homes

Gordon Estates  
Phoenix, AZ  
mandalayhomes.com

"We love our home. We have enjoyed being here so much ... When I saw my first bill and I compared it to my last home's bill, I was so impressed. This is such a wonderful home."

— Mandalay homeowner

Watch the  
video

Video

Click



**Consumer Experience**

...insulation system for comfort  
...protection  
...healthier  
...indoor air  
...High-efficiency  
...High-efficiency  
...advanced lighting technology for energy and water savings

Read more.

U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency &  
Renewable Energy

BUILDING TECHNOLOGIES OFFICE



DOE ZERO ENERGY READY  
HOME™ CASE STUDY

## Mandalay Homes

Phoenix, AZ



### BUILDER PROFILE

**Mandalay Homes**  
Builder: Dave Everson  
Phoenix, AZ, 602-964-3800  
info@mandalayhomes.com  
www.mandalayhomes.com

### FEATURED HOME/DEVELOPMENT:

#### Project Data:

- Name: Gordon Estates
- Location: Phoenix, AZ
- Layout: 4 bedrooms, 2.5 baths, 1 floor
- Conditioned Space: 1,700 ft<sup>2</sup>
- Completion: June 2013
- Climate Zone: 4
- Category: Affordable

#### Performance Data:

- HERS Index without solar PV: 58
- HERS Index with solar PV: 38
- Projected annual utility costs: without solar \$1,178; with solar \$905
- Projected annual energy cost savings (compared to a home built to the 2006 IECC): without solar \$583; with solar \$957
- Annual energy savings: with solar 10,135 kWh or 40.1 MMBtus; without solar 8,848 kWh or 30.2 MMBtus

When builder Dave Everson, owner of Mandalay Homes, first heard about the U.S. Department of Energy's Zero Energy Ready Home program, he was skeptical. The production home builder was focusing much of his time on affordable housing renovations for the City of Phoenix. The builder was already at better-than-code construction; he wondered how seeking even higher performance might impact the affordability of his homes.

But when the City of Phoenix awarded him the contract to build 14 new homes at Gordon Estates, a foreclosed subdivision of mostly empty lots, they stipulated that the homes should be a showcase for energy efficiency. When the previous builder foreclosed with only 6 of the 20 lots built, the property reverted to the city, which used federal Neighborhood Stabilization Program funds to sponsor the new construction there and in other Phoenix neighborhoods. The city recommended that Mandalay attain the National Green Building Standard (ICC 700) certification. Everson worked with green building consultant Philip Beere of G Street, who suggested the builder also pursue the EPA WaterSense and Indoor airPLUS certifications. Beere also introduced Everson to the DOE Zero Energy Ready Home program and suggested Everson use the HERS index as a design tool to pursue DOE Zero Energy Ready Home certification. Since the DOE program encompasses Indoor airPLUS and encourages WaterSense, DOE Zero Energy Ready Home certification was the next logical step.

Everson was taken with the idea of cutting his homes' HERS scores. "Everson really embraced the HERS index as a design tool. It became a challenge—how low can we go?" said Beere, who worked with Everson to bring his green homes to market. G Street provided third-party certification management, marketing tools, homeowner education, and design guidance. Everson had been following ENERGY STAR Version 2.0 for air sealing before Gordon Estates and analysis of some of his previous market-rate homes showed he had been achieving HERS scores in the

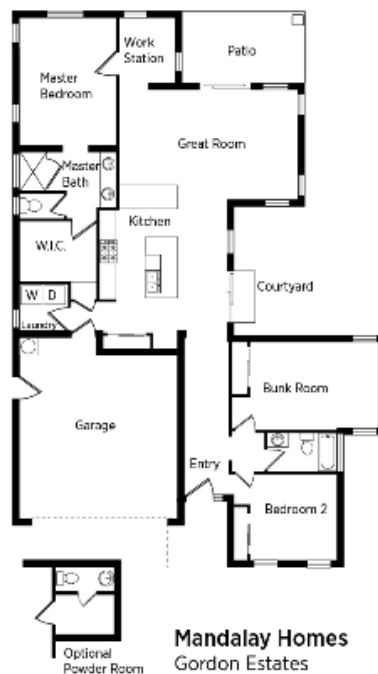


The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program (formerly known as Challenge Home). Every DOE Zero Energy Ready Home starts with ENERGY STAR for Homes Version 3 for an energy-efficient home built on a solid foundation of building science research. Advanced technologies are designed in to give you superior construction, durability, and comfort; healthy indoor air; high-performance HVAC, lighting, and appliances; and solar-ready components for low or no utility bills in a quality home that will last for generations to come.

# Showcase: Tour of Zero

"WHEN I SAW MY FIRST BILL AND I COMPARED IT TO MY LAST HOME'S BILL, I WAS SO IMPRESSED."

## DOE TOUR OF ZERO FLOORPLANS: GORDON ESTATES BY MANDALAY HOMES



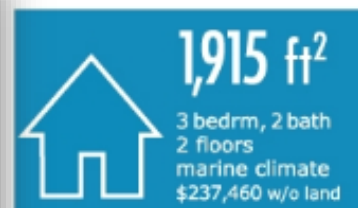
advanced lighting technology for energy  
and water savings

[Read more.](#)

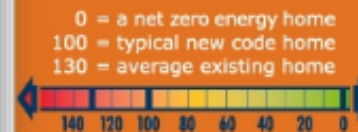
[More ...](#)

[the Builder](#)

Click



**HERS -1** This home's score w/PV



**-\$94** Average monthly energy bill\*

\$2,677 saved per year\*  
\$113,853 saved over 30-yr mortgage\*\*

\*actual w/delivery charges and \$0.15/kWh PV credit; \*calculated; \*\*calculated with fuel escalation rate per 2014 EIA Annual Energy Outlook

# Showcase: Tour of Zero

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

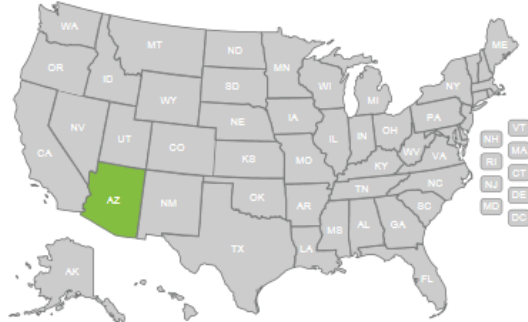
## DOE Zero Energy Ready Home: Partner Profile

### Mandalay Homes



Partner ID: 620  
Organization Type: Builder  
Main Contact: Dave Everson  
Address: 2320 E BASELINE RD #148-005  
PHOENIX, AZ 85042  
Primary Phone Number: (602) 864-3800  
Certified DOE Zero Energy Ready Homes (2012 - Present): 161  
Certified Builders Challenge Homes (2008 - 2012): 0  
Website: <http://www.mandalayhomes.com>

### All Places of Business

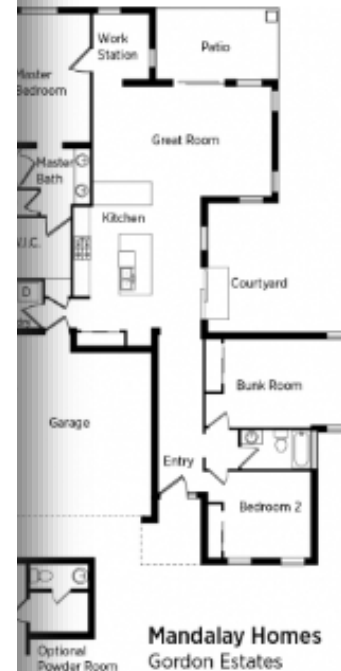


AZ

### Commitments



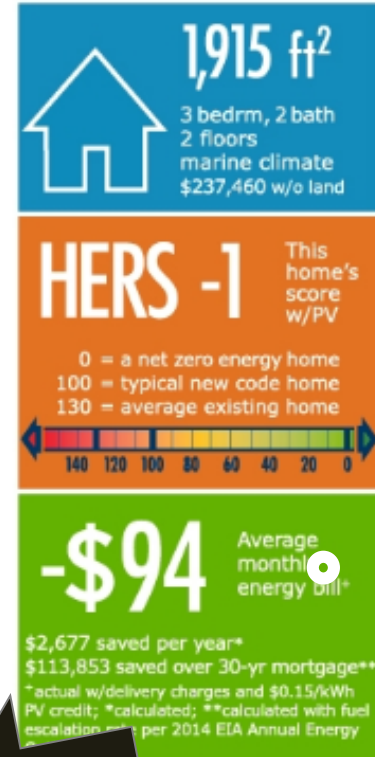
## MY LAST HOME'S BILL, I WAS SO IMPRESSED."



Mandalay Homes  
Gordon Estates

More ...

Meet the Builder



Click



